

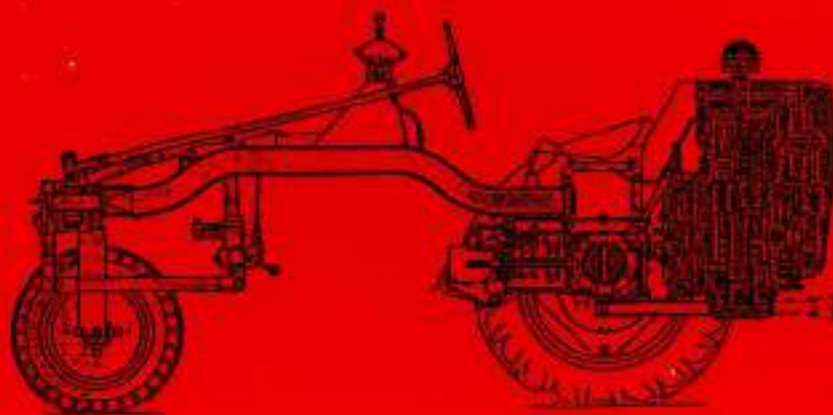
DAVID BROWN

2D

REPAIR MANUAL

SECTION I — ENGINE

AGRICULTURAL TRACTOR
Series VAD/12 and VAD/12V



DAVID BROWN INDUSTRIES LIMITED

TRACTOR DIVISION

MELTHAM · HUDDERSFIELD · ENGLAND

DAVID BROWN

2D

REPAIR MANUAL

SECTION I — ENGINE

DAVID BROWN INDUSTRIES LIMITED

DBT 433

D5801

INTRODUCTION

This manual is intended to guide the service man in the dismantling, repairing and rebuilding of the 2D tractor. It does not give detailed directions for stripping and rebuilding, when these are obvious, as it is not intended to serve as a service instruction book. The assumption has been made that those responsible for the repair of the tractor will be generally conversant with mechanical engineering principles and in most instances will be fully qualified fitters.

It is assumed that the particular item being repaired is the only one receiving attention at the time. For the purpose of a complete overhaul the various units should be stripped from the main frame and then dealt with individually. The following order will be found most satisfactory.

Remove the engine bonnet and grill, instrument panel, wheel mark remover and towing bar, lift out the engine complete detaching it at the bell housing. Remove battery housing, fuel tank and mudguards in one piece. Next disconnect the clutch and brake rods at the rear end and remove the floorplate. Remove the air lift linkage, rams and operating mechanism, also the steering column, rack and pinion, and steering rods. Support the rear of the tractor firmly under the gearbox; remove the wheels and reduction units. Support the front of the main tubular chassis and remove the front wheels and axle. The chassis may then be disconnected from the gearbox.

It is impossible to give precise directions when to renew a particular item. This is more a matter of common sense and judgment, which comes with experience. It is good practice, however, always to replace disturbed packings and gaskets with new ones and it is essential to fit new oil seals after dismantling.

Only genuine David Brown spares should be fitted as replacements and when ordering always quote the tractor and engine serial numbers which can be found on the plate at the L.H. side of the steering support.

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SECTION I—ENGINE

Most work on the engine can be carried out without removing the engine from the tractor. If access is required to the clutch and flywheel the engine should be removed complete as described opposite. For working on the crankshaft and main bearings the engine must be removed from the tractor, but may be removed at any convenient stage of engine strip.

For the SD2 and MD2 Engines this section may also be used if the instructions referring to purely tractor items are ignored. The basic engine unit is identical to that used in the tractor and overhaul and repair are effected in a similar manner. Details of the clutch and output bearing of the SD2 are shown at the end of this section.

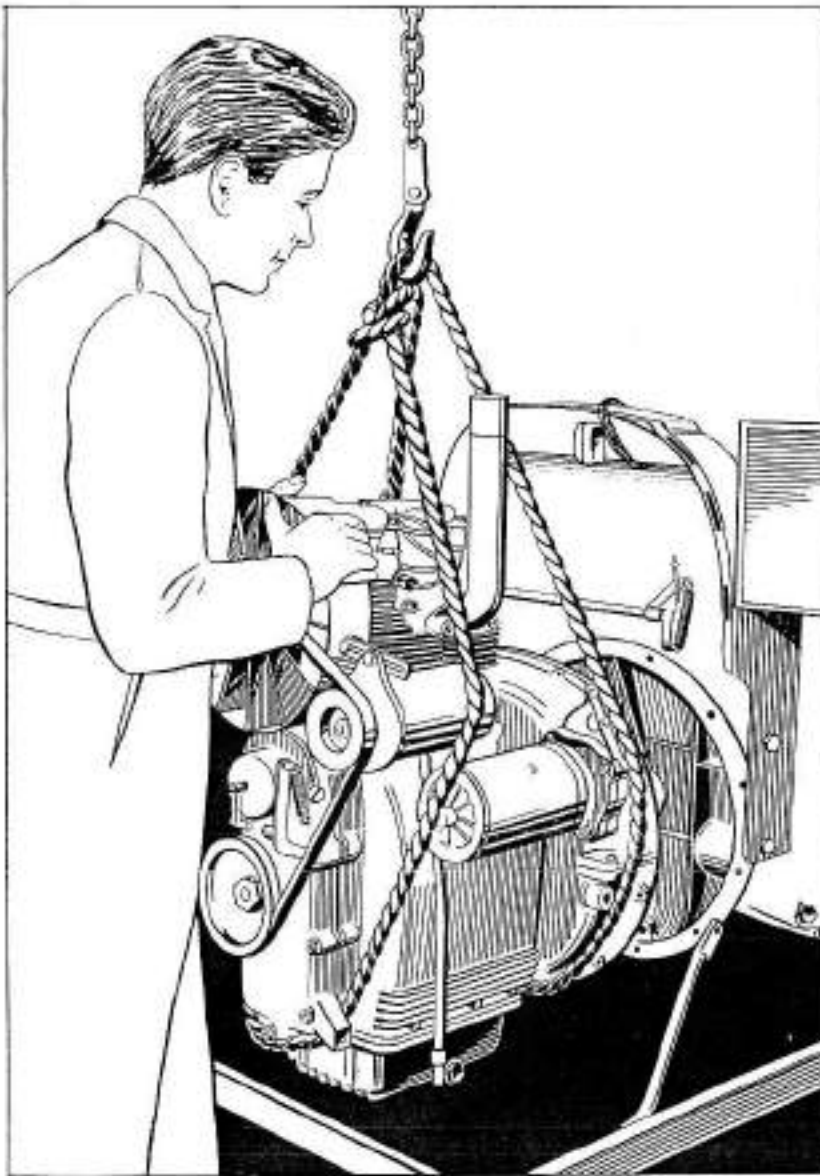


FIG. 1 LIFTING THE ENGINE OUT

REMOVING THE ENGINE FROM THE TRACTOR

Air Cleaner

Remove the air cleaner. On some models fitted with a heavy duty air cleaner, it will only be necessary to remove the pre-cleaner.

Bonnet

Unclip the bonnet centre and remove. Disconnect the tie bar at the bonnet rear. Lower the wheel mark removers and remove two $\frac{3}{8}$ in. Whit. bolts at bottom and lift off.

Battery

Remove the cover and disconnect the leads. To facilitate lifting out the battery, thread a piece of cord under two of the cell connecting bars to make a lifting handle. Lift the battery out and put on charge for future readiness.

Wiring

Disconnect the starter button bracket and the lead from the starter. Having freed the starter button, disconnect the lead from the battery at the button. Undo the clip on the bell housing and remove the lead forwards through the battery compartment.

Undo the dynamo leads at the dynamo, break the lighting connections in the battery compartment, pull the wires through and hang the starter button and regulator over the instrument panel by the wires. These will then be out of the way for subsequent removal of the engine.

Exhaust Pipes and Manifold

Slacken the exhaust pipe manifold at the elbows and at the connections to the exhaust pipe. Tap the manifold upwards with a hide mallet to remove.

Fuel Pipe

Disconnect the fuel pipe clip from the bell housing and undo the pipe at the connection to the sediment bowl. Bend the pipe gently upwards until the end is above the level of fuel in the tank to avoid having to drain the tank.

Throttle Control Rod

Slacken the locknuts at the control rod adjusting nut at the right hand side of the engine. With the throttle in the open position undo the adjusting nut until the two halves separate.

Injector Leak-off Pipe

Disconnect the return pipe and fuel leak-off pipe at their connection.

Towing Bracket Stays

Disconnect the towing bracket stays at the bell housing and push the towing bar downwards out of the way.

Bell Housing

Undo the bolts connecting the lower half of the bell housing to the clutch housing. Fix two equal length rope slings under the engine, one under the timing case and one under the bell housing. Attach to a hoist and take a little of the weight of the engine. Remove the remaining bell housing bolts. Take the weight of the engine on the hoist and remove the engine with a straight pull rearwards to prevent distortion of the clutch shaft as it is withdrawn.

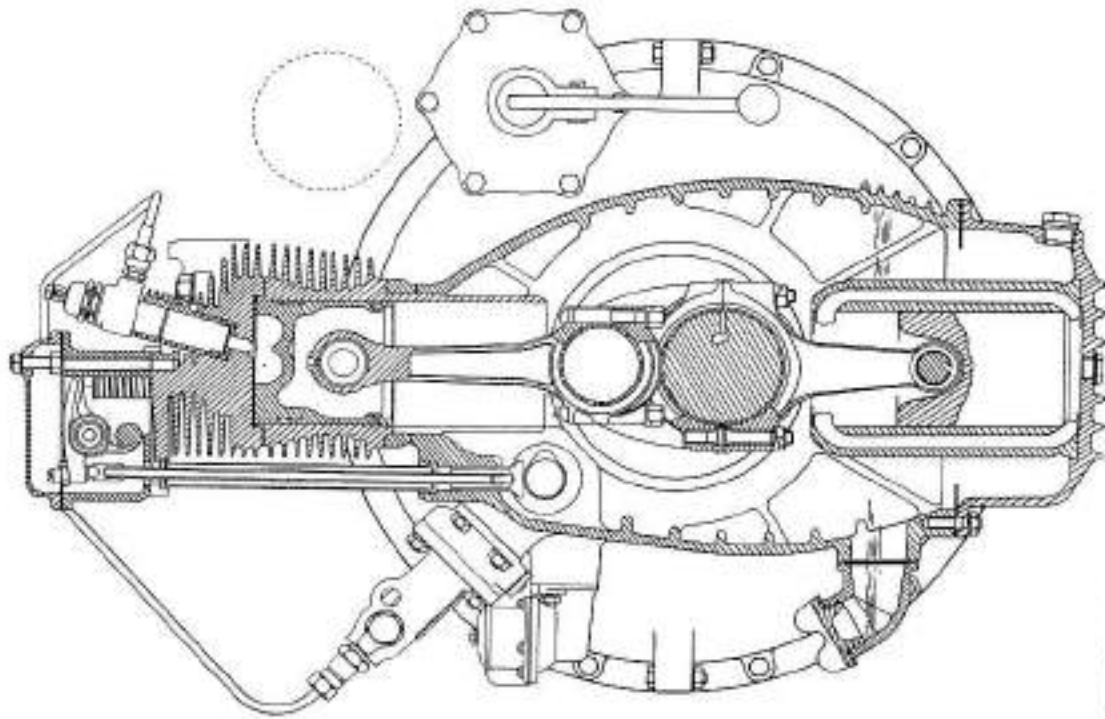
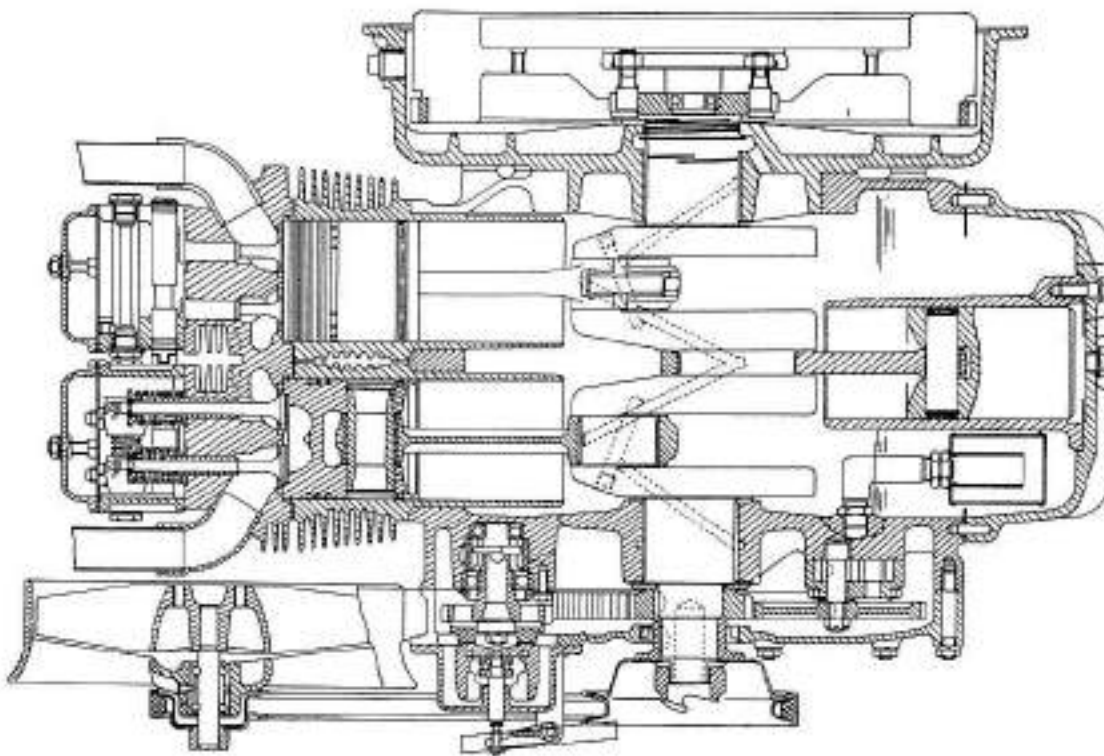


FIG. 2 SECTIONS THROUGH THE ENGINE



ENGINE OVERHAUL

For a complete strip and overhaul of the engine it is recommended that the order depicted by the main headings in this section be followed. However, where repair to one item only is concerned proceed direct to the heading required. If no specific instructions are given for reassembly this will be a straight forward reversal of stripping. It should be noted, however, that new packings or oil seals should always be fitted where applicable.

If the engine has been removed from the tractor, stand it on its sump on the bench.

Injector Pipes and Injectors

Remove Bonnet Centre.

Remove the banjo bolts at the oil supply pipe to the rockers and push the pipe to one side. Disconnect the injector pipes at both ends and lift clear.

Remove the leak-off pipe, replacing the banjo bolts in the injectors for safety, and to keep the dirt out. Unscrew the injector securing nuts evenly and remove the injectors. If they are tight in the head due to carbon, tap the injector sideways gently on the lug to break the seal. Do not lever against the fins of the cylinder head or injector sleeve as these are easily damaged which will impair the cooling efficiency. After removing the injector put a piece of clean cloth in the opening in the cylinder head to prevent dirt entering the cylinder.

Replacement—Before replacing, clean all carbon from the inside of the copper sleeve taking care not to damage the seat. Tighten the injector evenly, each nut a little at a time. Tighten firmly but do not overtighten or the injector will be distorted. Check that compression is present in each cylinder.

NOTE:—The copper washer which is sometimes supplied with new nozzles should *not* be used otherwise the sprays will impinge on the head giving inefficient combustion and smoky exhaust.

Cleaning—The injectors are precision pieces of equipment and should be handled carefully. When the pipes are removed the orifices should be covered to prevent ingress of dirt. When removed from the engine the nozzle tips should be protected from damage by a suitable cap of plastic or cardboard. The nozzle is of multi-hole type having four holes spaced at 90° intervals looking in plan view, and inclined downwards to give an inclusive cone angle of 140°. This is offset 10° to allow for the fact that the injectors are inclined 10° in the head.

- A. Leak-off union
- B. Dome nut
- C. Pressure adjusting screw
- D. Locknut
- E. Pressure spring
- F. Nozzle holder
- G. Pressure union
- H. Needle valve
- J. Nozzle
- K. Nozzle cap nut
- L. Valve plunger

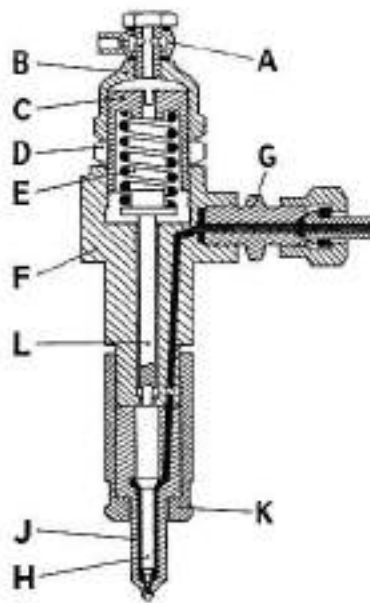


FIG. 3 SECTION OF INJECTOR

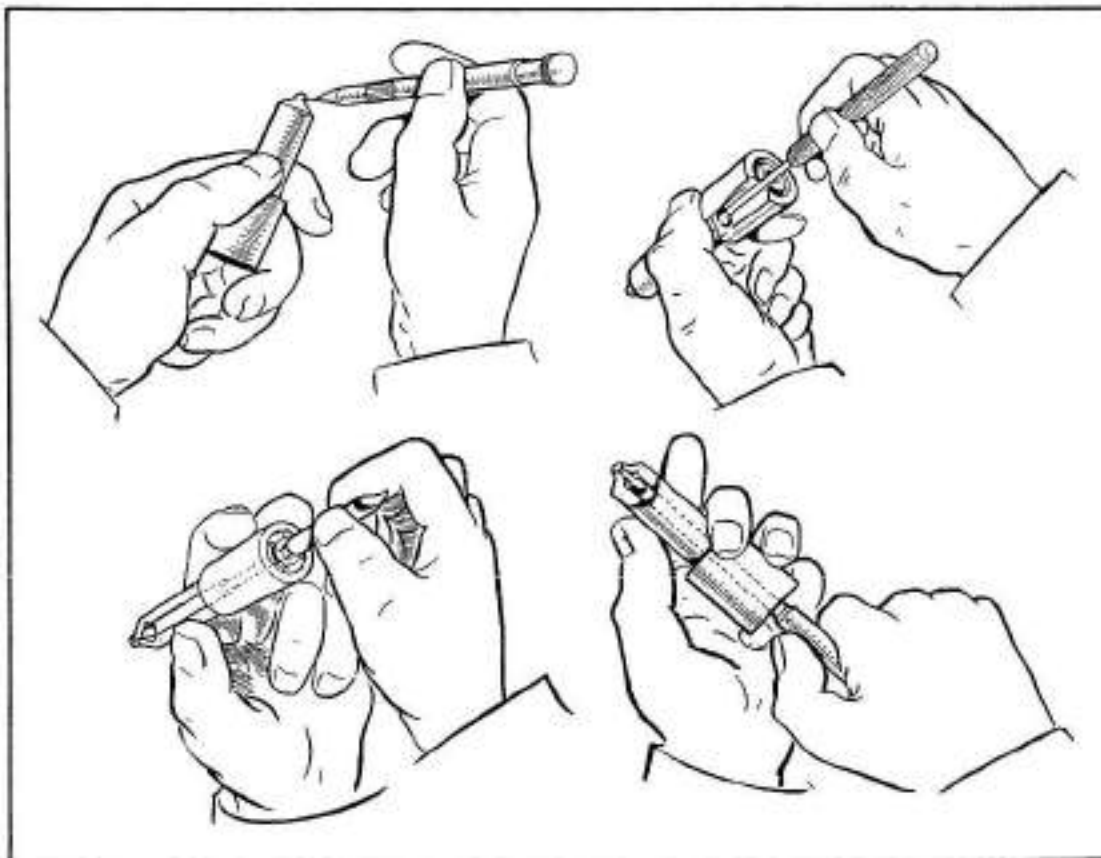


FIG. 4 CLEANING THE NOZZLE

A special kit of nozzle cleaning tools is available. The bench to be used for servicing fuel injection equipment should be prepared in a well lighted and separate part of the workshop. If it is possible a dust proof room should be used in which the test equipment can be permanently installed.

Refer to fig. 3. Remove the excess carbon from the outside of the nozzle and cap. Remove the cap B, slacken the locknut D and unscrew the pressure setting screw C until the tension is taken off the spring. (This is necessary to prevent distortion of the needle when removing or replacing the nozzle.) Hold the injector firmly by the flats on the body above the securing lugs or in a special jig having locating pegs for the holes in the holding down lugs. Unscrew the nozzle retaining cap K and remove the nozzle taking care of the needle. Place in a bath of petrol to soften the carbon.

With the special tools provided in the cleaning kit scrape the carbon from the needle seat, and from the fuel sac. Clear the oil passages and using the wire probe ensure that the spray holes are clear. The correct diameter of probes should be used (marked 020) and care taken not to break them in the hole. Assemble the nozzle, without the needle, in the reverse flushing attachment (if available) and wash all traces of dirt away by fixing to the injector tester and forcing oil through under pressure. Place the clean nozzle in a dish of clean "Fusus" or "Ensis" oil until ready for assembly.

With the wire brush gently clean the needle paying particular attention to the seat. Examine the seat for scoring, damage, or overheating. Should any of these be evident the nozzle should be serviced by a C.A.V. engineer.

Reassemble the needle into the nozzle under the surface of the oil making sure that it slides smoothly and easily. Needles and nozzles are selectively assembled and must not under any circumstances be interchanged.

Pressure Setting—After reassembling the nozzle on to the holder, the spring adjusting screw should be given an initial tightening and the assembly attached to the injector test machine. Pump up the machine until fuel is ejected from the nozzle, allow several strokes to clear the air from the system. Open the valve to the gauge and screw down the adjustment until the "breaking" pressure is just 175 atmospheres (185 atmospheres for the initial setting of a new injector). Tighten the locknut and fit the dome nut. With the valve to the gauge closed, give a few quick injections and examine the spray form to ensure that all four are even and finely atomized.

Warning

Great care should be taken not to allow hands near the sprays as they have great force and will easily penetrate the skin. The resulting injury can be serious and difficult to treat. A tin canister should be placed round the nozzle for safety during tests.

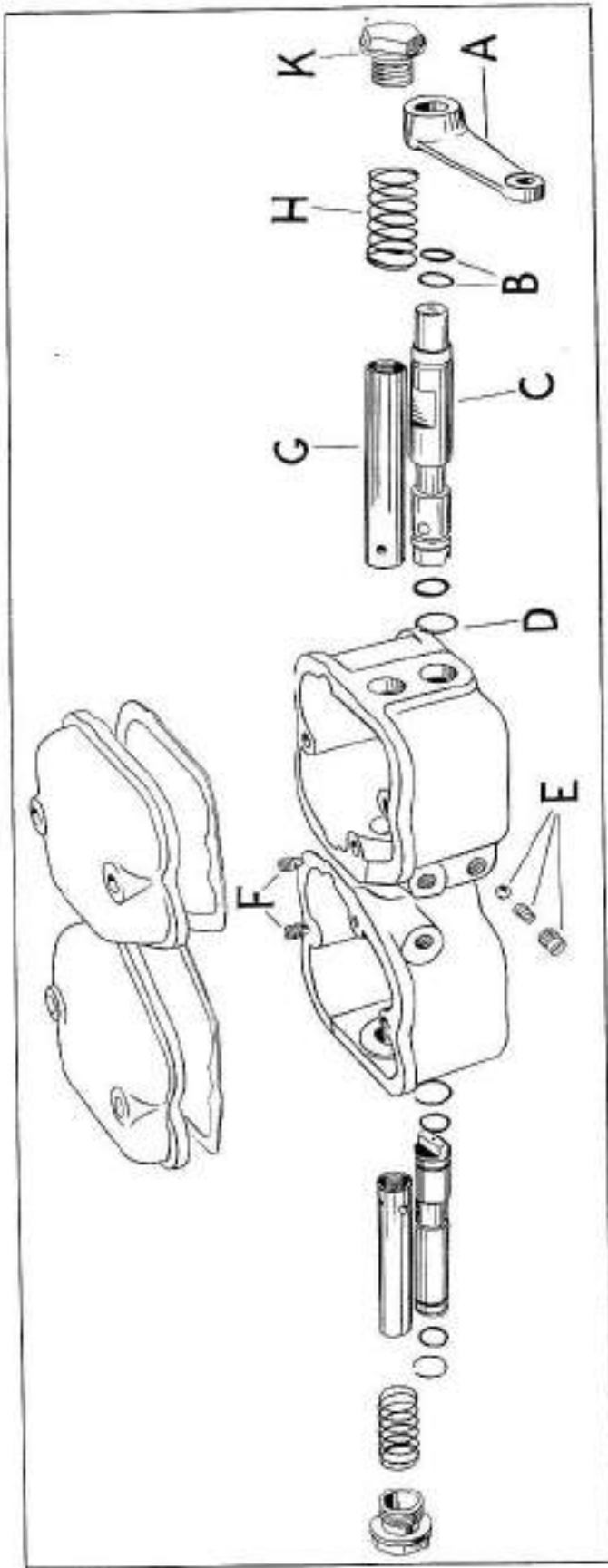


FIG. 5 EXPLODED VIEW OF ROCKER BOXES

- A. Decompressor lever
- B. Decompressor shaft sealing rings
- C. Decompressor shaft
- D. Cirdip securing decompressor shaft
- E. Indent ball, spring, and securing screw
- F. Rocker shaft securing screws
- G. Rocker shaft
- H. Rocker spacing spring
- K. Rocker shaft plug and washer

Rocker Boxes

Sealing washers are fitted under the nuts securing the rocker box covers. If these are in reasonable condition they may be retained and refitted on assembly.

Remove the $\frac{7}{16}$ in. Allen screws inside the bottom of the rocker boxes (two in each box). Remove the nuts and spring washers from the cover studs. (These studs are fastened in the head and also secure the rocker boxes.)

Disconnect the decompressor operating rod by removing the split pin.

Lift the rocker boxes off vertically together and remove the push rods noting their order for replacement in the same positions.

Remove the plugs from each end of the rocker shaft. Remove the grub screw, insert a soft drift into the end of the shaft and tap through gently. Remove rockers and springs.

Should oil leak from the ends of the decompressor shaft, it will be necessary to replace the oil seals. The front shaft may be withdrawn easily after removal of the circlips. The shaft with the operating arm must first have removed the plug, spring, and ball which locate it.

Replacement—Before fitting the decompressor shaft ensure that there are no sharp corners on the bores. Fit new rubber sealing rings to the outer end of the shaft (on early engines there may be only one seal at each end). Apply to the seals a suitable lubricant such as "Pressoline" No. 2 drawing compound thoroughly mixed (one part "Pressoline" to three parts water.)

Enter the shaft by the end without seals and fit the seals after passing through the first bore. Apply lubricant and carefully push the shaft home taking care not to cut the seals as they enter the bores. Fit the circlip and also the ball and spring to the rear shaft.

New bushes may be fitted to the rockers after pressing the old ones out but must be broached or reamed to size after fitting. Ensure that the oil hole in the bush lines up with the oil hole in the rocker when pressed in. After refitting the rocker shaft line up the locating hole in the shaft before screwing home the grub screw. Fit new washers to the end plugs. If a new rocker shaft is being fitted it is advisable to file a small chamfer on to the end which is inserted first to prevent scoring of the rocker bushes.

When fitting the rocker boxes to the cylinder head remember to fit the plain washers under the Allen screws. Ensure that the decompressor shaft in the front rocker box is the correct way round and that the coupling between the two halves fit together correctly. It is recommended that the two boxes be fitted over the studs together with the decompressor shafts correctly interlocked. It is advisable to slacken the tappet adjusting screws before fitting. Ensure that the adjusting screws fit into the push rods and set the valve clearance to .003 in. (.08 mm.) cold. When the engine warms up this clearance increases to its working value. Should the clearance be set while the engine is warm the clearance will reduce when cold and may hold the valves open thus preventing compression and making it impossible or very difficult to start the engine.

Fit the aluminium sealing washers under the rocker cover nuts.

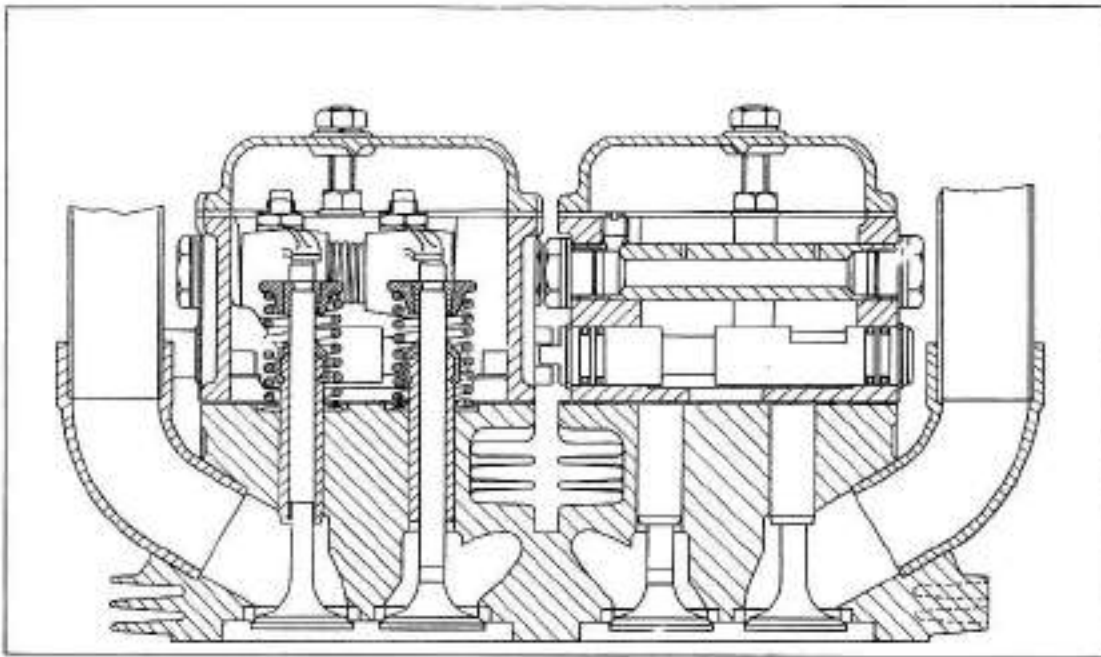


FIG. 6 SECTION OF CYLINDER HEAD

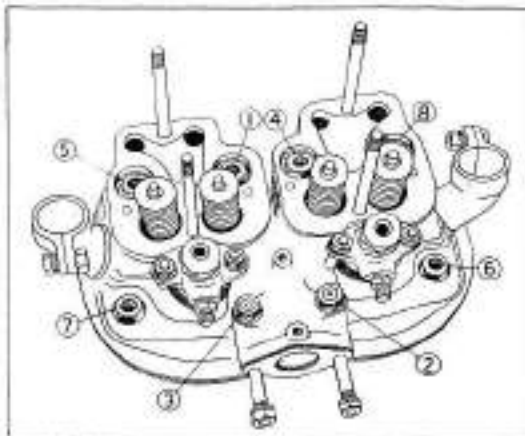


FIG. 7 CYLINDER HEAD
TIGHTENING SEQUENCE

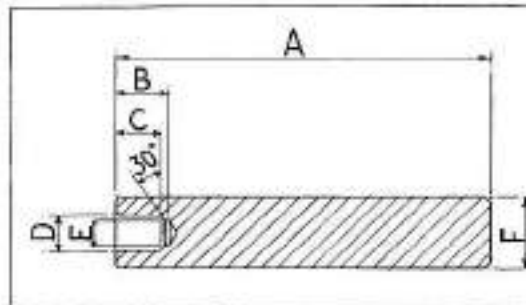


FIG. 8
VALVE GUIDE INSERTING TOOL

- A. $6\frac{1}{2}$ in. (165 mm.)
- B. $\frac{11}{16}$ in. (20.6 mm.)
- C. $\frac{11}{16}$ in. (17.5 mm.)
- D. $\frac{7}{16}$ in. (14.3 mm.) dia.
- E. $\frac{3}{8}$ in. (9.52 mm.) dia.
- F. $1\frac{1}{4}$ in. (28.6 mm.) dia.

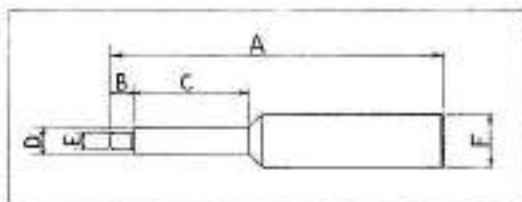


FIG. 9
VALVE GUIDE EXTRACTOR TOOL

- A. $7\frac{1}{2}$ in. (190 mm.)
- B. $\frac{1}{2}$ in. (12.7 mm.)
- C. 3 in. (76 mm.)
- D. 0.555/0.550 in. (14.10/13.97 mm.) dia.
- E. 0.3403/0.3383 in. (8.644/8.593 mm.) dia.
- F. $1\frac{1}{4}$ in. (2.86 cm.) dia.

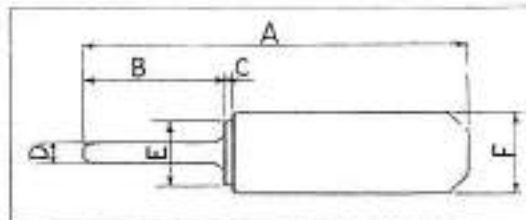


FIG. 10
VALVE SEAT INSERTING TOOL

- A. 7 in. (178 mm.)
- B. $2\frac{1}{2}$ in. (66.6 mm.)
- C. $\frac{3}{4}$ in. (3.6 mm.)
- D. 0.3403/0.3383 in. (8.644/8.593 mm.) dia.
- E. $1\frac{1}{16}$ in. (30.22 mm.) dia.
- F. $1\frac{1}{2}$ in. (38.1 mm.) dia.

Cylinder Head

The rocker boxes must be removed to gain access to the cylinder head holding down nuts. Remove the air inlet pipe or the heavy duty cleaner as the case may be. If the injectors are to be tested or cleaned or the head worked on, it is advisable to remove them before lifting the head, otherwise they may be left in place.

Remove the eight cylinder head holding down nuts and lift the head vertically. Break the carbon seal between the head and the barrels to prevent lifting the barrels off with the head.

Remove the push rod tubes and seals.

Fig. 6 shows the various components of the cylinder head. To remove the valve guides firstly remove the studs in the top face of the head, support in a press and with a suitable guided tool (see fig. 9) push the guide upwards through the head. Press a new guide $1\frac{1}{2}$ ins. (3.8 cm.) into the head. The special tool shown in fig. 8 should be used as it is important that the sharp edge at the top of the guide should not be chipped or damaged. It is advisable to heat the head first. A temperature of 200°C should not be exceeded.

Slightly pitted valve seats and faces may be lapped in with grinding paste. Check the completed seat by applying a thin film of engineers blue to the valve face and giving the valve a part turn on the seat. A complete seal all the way round should be produced.

If the seat is deeply pitted or the face badly grooved the seat should be re-cut and the valve face ground free from markings on a valve grinding machine. The valve and seat are at 45° and should be lightly lapped in after grinding. If after cutting, the valve seat is much more than $\frac{1}{16}$ in. (1.6 mm.) wide, a new seat insert should be fitted and cut to approx. $\frac{1}{32}$ in. (.8 mm.) wide. Care should be taken when removing the old seat not to damage the cylinder head. A sharp blow with a cold chisel may fracture the seat, which can then be removed easily. If equipment is available the seat may be machined out. The new insert should be frozen in solid carbon-dioxide and hammered in immediately, with a special tool similar to that shown in fig. 10. Do not touch the ice or cold seat or a blister will result. The head should be warmed also for additional ease of fitting, heating of the head alone is not sufficient.

Replacement—The neoprene oil seals fitted to all valve guides should be renewed at each decarbonisation and whenever it is suspected that the scraping edge has been worn or excessive heat has caused the material to harden:

Fit a new cylinder head gasket with the bead to the barrels. Fit new oil seals at the top and bottom of the push rods tubes. Fit the tubes, and lower the head into position guiding the tubes into position. Fit plain washers and nuts, tightening each a little at a time in the sequence shown in fig. 7. Use a torque wrench set to 44 lb. ft. (6.07 KgM.). Check that the push rod tubes have been gripped and cannot be turned by hand. In the rare event of a tube being loose, the head will have to be slackened off and a thin packing washer fitted under the appropriate seal.

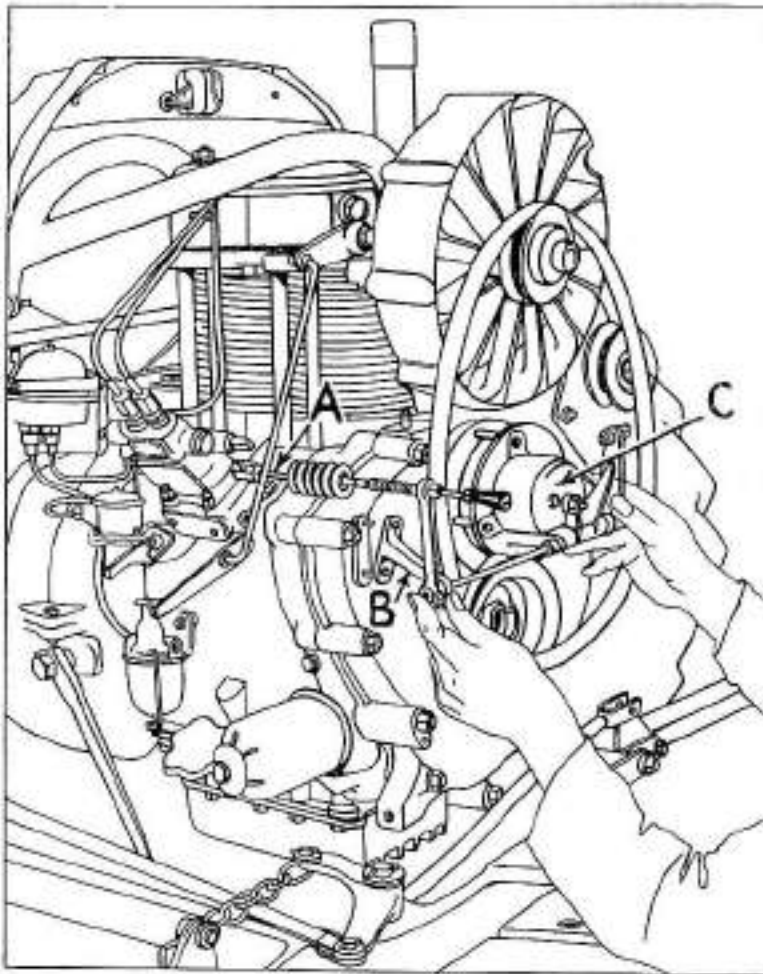


FIG. 11 FAN BELT REMOVAL

A. Rack control rod B. Cross shaft support bracket C. Governor housing

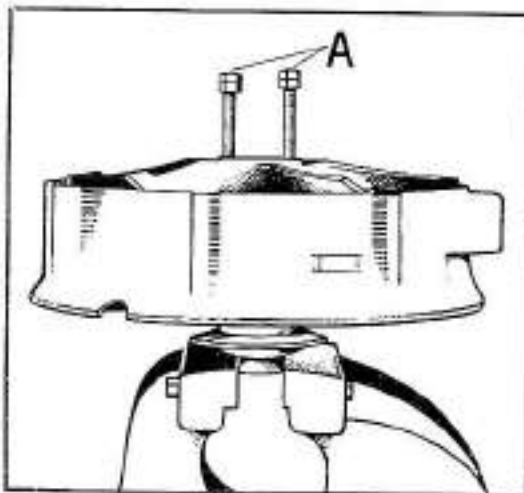


FIG. 12

DRAWING THE FAN OFF THE HUB

A. Threaded rods

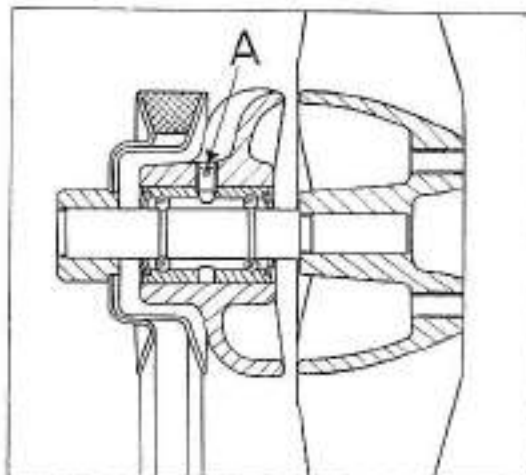


FIG. 13

SECTION THROUGH FAN BEARING

A. Bearing locating screw

Fan Belt Replacement

If it is desired only to replace the fan belt it will first be necessary to remove the bonnet and grill. Then proceed as follows:—Slacken the dynamo or jockey pulley so that the belt is loose. Disconnect the rack control rod at the injection pump after sliding the dust bellows along the rod (see fig. 11). Disconnect the rod to the governor quadrant preferably at one end or the other so as not to disturb its length. Unfasten the nuts securing the governor housing and the cross rod support bracket. Remove the complete assembly as shown in fig. 11. The belt may now be renewed and the governor mechanism refitted. By adopting this method and taking great care not to disturb the relationship between the levers and governor thrust button it will not be necessary to reset the governor.

Re-assembly—Turn the engine so that the governor weights are one at each side and will stay wide apart so that the thrust race can be entered without difficulty.

Cooling Fan

Slacken the dynamo at its pivot points (or the jockey pulley where a dynamo is not fitted) and disconnect at the stay to the fan cowl. Remove the fan belt from the pulleys. Remove the two securing bolts between fan cowl and cylinder block and remove the fan assembly. A socket wrench with universal joint is most useful for removing these nuts although with some makes it may be necessary to grind the outside diameter for clearance.

Bolt the tool to the fan hub and push the shaft out by screwing on the centre jack screw. If the special tool is not available, draw the fan off the spindle using two $\frac{3}{16}$ in. Whit. threaded bolts in the holes provided, screwing each a little at a time to jack the fan off. (See fig. 12.)

Remove the grub screw (A fig. 13) situated just behind the vee pulley. Tap the bearing and pulley complete out of the housing.

Support the pulley on a suitable sleeve fitted over the bearing and press the bearing spindle through the pulley.

All fans are statically balanced to within .10 oz. (2.8 gms.) at a radius of 5 ins. (12.7 cm.) during manufacture. Should a fan blade be damaged the fan will require replacement (or rebalancing if the damage is slight).

The bearings are packed with high melting point grease during manufacture and should not require attention.

Jockey Pulley

Fitted to maintain the fan belt tension when a dynamo is not fitted, the bearings are packed with high melting point grease when new and should not require further attention. The bearing and vee pulley may be pressed out of the housing after removing the grub screw. The pulley is a press fit on the spindle. Should the pulley or the bearing require renewing and these items have both seen long service it may be more economical to renew both at the same time.

Dynamo

Remove the dynamo, crankcase breather pipe and dynamo bracket. Servicing of the dynamo is dealt with in the Electrical Section.

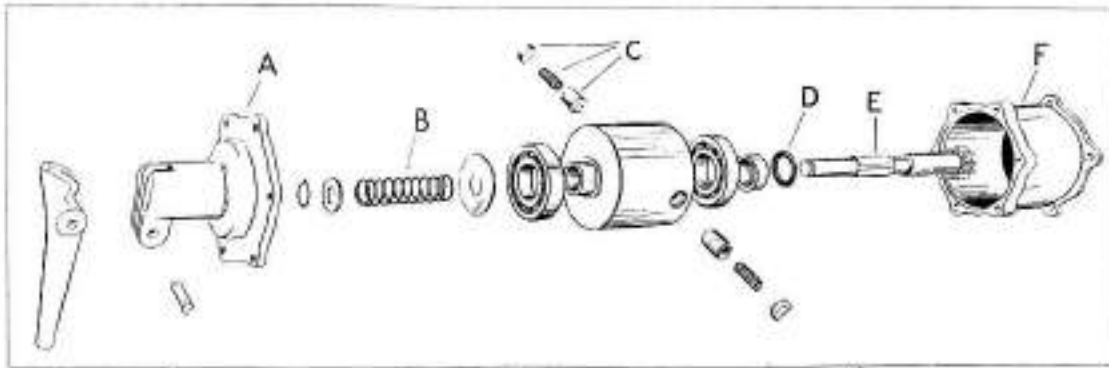


FIG. 14 EXPLODED VIEW OF INERTIA STARTER

- | | |
|------------------------------|-----------------|
| A. End cover | D. Rubber ring |
| B. Return spring | E. Pinion shaft |
| C. Plug, spring, and plunger | F. Casing |

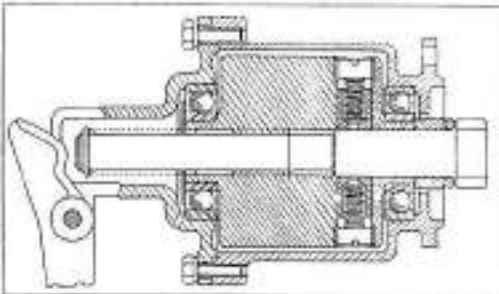


FIG. 15 SECTION OF INERTIA STARTER

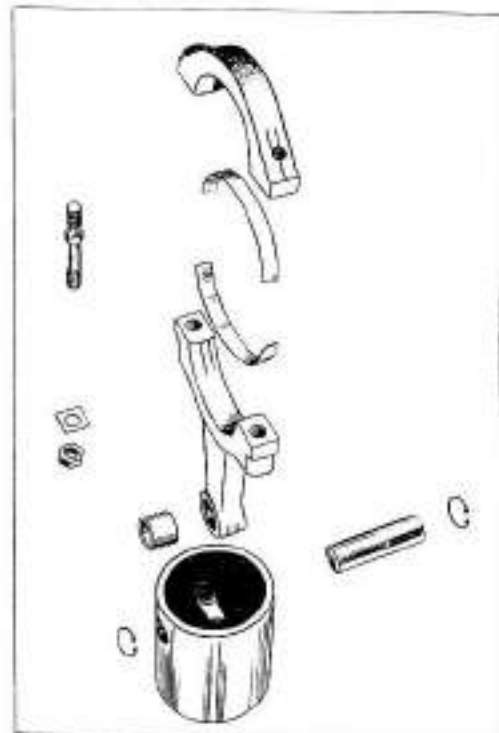


FIG. 16 EXPLODED VIEW OF BALANCING PISTON AND CONN-ROD

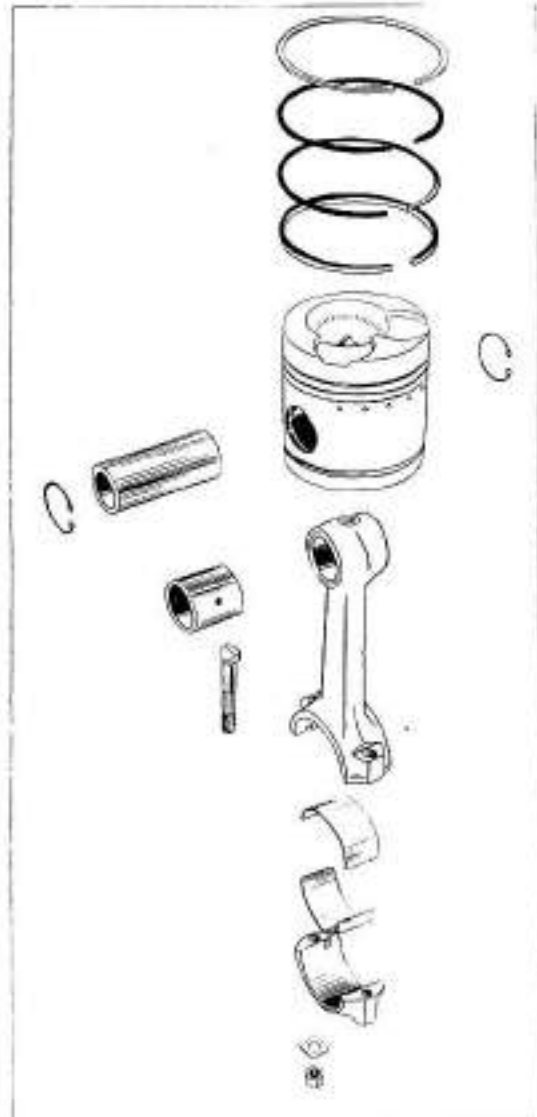


FIG. 17 EXPLODED VIEW OF CONN-ROD AND PISTON

Starter

Remove the electric starter or inertia starter. With the electric starter, remove also the distance piece which is also the support bracket for the regulator and starter button.

To dismantle the inertia starter grip the body firmly in the vice. Remove the end cover (A fig. 14) tapping it off the ballrace. Remove from the vice, tap the casing (F) downwards and lift the flywheel assembly out.

Compress the return spring and remove the circlips. Remove the washer, spring and chip shield.

Remove the two plugs (C) springs and plungers from the flywheel. The plugs are centre punched to prevent them coming loose and may be difficult to remove. Use a large well sharpened screwdriver. A wheel operated screw driver, similar to that used for releasing the pole shoes on the dynamo would be an advantage. Withdraw the pinion shaft rubber ring and distance piece. Lever the ball races off the flywheel.

Replacement—Fit a new pinion shaft if worn on the splines or pinion. Ensure that the tips of the teeth are flame hardened as shown by the colouring.

Pack the bearings with grease, lubricate the splines and plungers with graphited oil, centre punch the plunger plugs after tightening.

Pistons and Connecting Rods

Remove the sump. This is complete with the balancing cylinder and it is advisable to remove the plug in the bottom to allow air to enter the cylinder otherwise the sump will be difficult to draw off.

Untab the washers on the balancing conn-rod and remove the two nuts. Pull the piston and rod off, remove the bearing cap with its bolts from the crankshaft and replace with the rod.

Untab the washers and remove the nuts and lower halves of the big end bearings. Push the conn-rod and piston up through the top of the barrel. Replace the big end cap on the rod to retain the parts together.

Re-assembly—The conn-rod and cap are machined as a pair and must be kept together. Identification numbers are stamped on the side of the bearing on rod and cap, these should be adjacent when the cap is fitted to the rod and should be on the camshaft side of the engine.

In order to ensure an accurate balance of the crankshaft the conn-rods are selectively assembled from three weight groups, H (heavy), M (medium) and L (light) the appropriate symbol being stamped on the side of the rod and caps. If a rod has to be replaced, one of the same weight should be fitted. Some of the early conn-rods were not stamped and should be regarded as M weight. Fig. 18 shows the only permissible combinations.

If the bearing surfaces are worn or breaking up, new shells should be fitted. No attempt should be made to take up wear as no provision is made for this. The replaceable type shells are machined to very close limits and must not be filed or scraped.

If bearing failure has taken place due to oil starvation the cause of this must be ascertained and rectified before replacement.

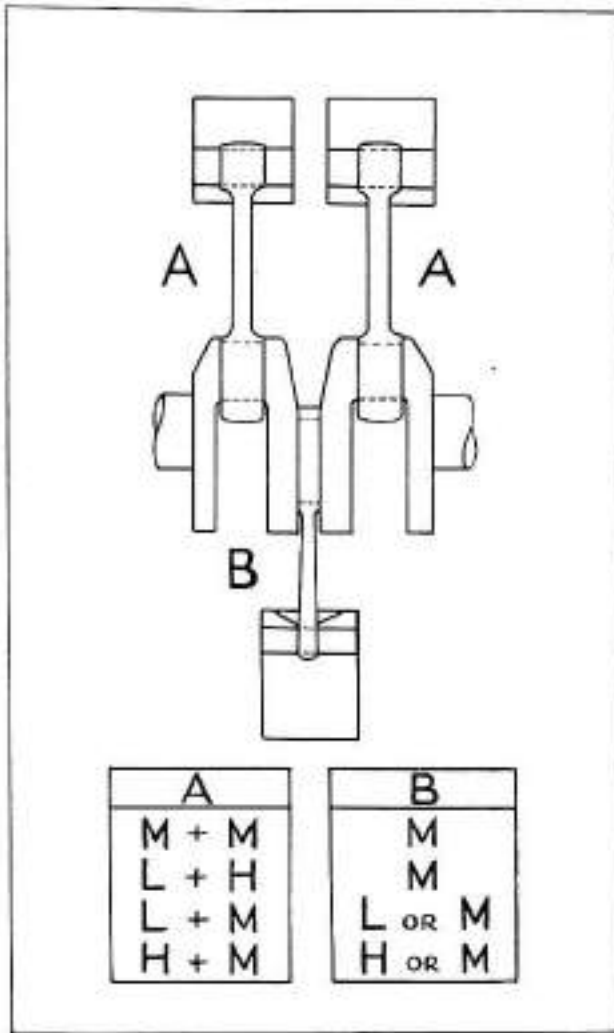


FIG. 18
PERMISSIBLE COMBINATIONS OF
CONN-ROD WEIGHTS

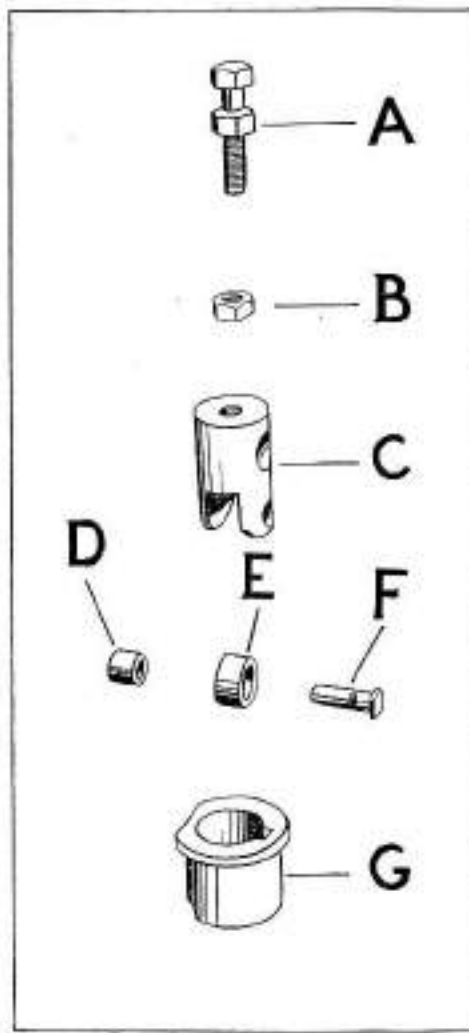


FIG. 19 EXPLODED VIEW OF
INJECTION PUMP TAPPETS

- A. Tappet
- B. Locknut
- C. Body
- D. Bush
- E. Tappet roller
- F. Guide pin
- G. Guide sleeve

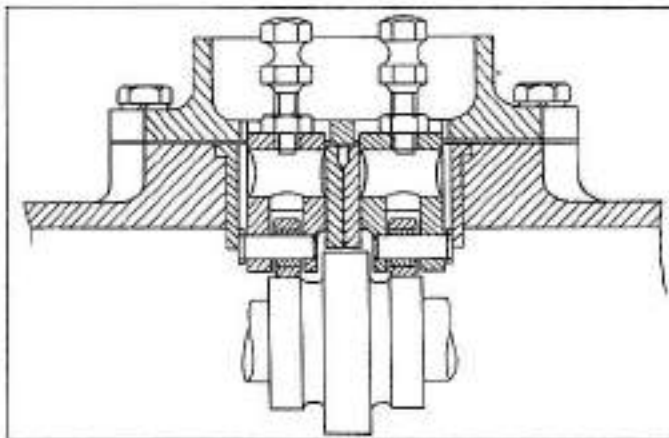


FIG. 20 SECTION OF INJECTION PUMP TAPPETS

Before reassembly clean all parts, ensure that the oilway is clear of residue, especially metal bits from worn or failed bearings, and examine the crankshaft for scores and wear. Regrind if necessary.

When fitting the shells make sure that the housing and the back of the shells are perfectly clean. The importance of this is not often realised. A speck of dirt behind the bearing can cause a high spot which may result in failure. Apply a thin film of oil to the conn-rod, fit the shell, apply oil to the bearing surface and also liberally to the piston and rings. Enter the piston and conn-rod assembly from the top of the barrel using a piston ring clamp to enter the rings. It is advisable to space the ring gaps round the piston so that no two are near together. Check that the valve recesses in the pistons are to the camshaft side of the engine. Fit new tab washers to the big end bolts and tighten to the correct torque. (See page 39.)

Before refitting the sump replace the gasket with a new one. Ensure that the two dowels are in position. Check to see that the oil pump inlet elbow and gauze are in place. Fit the sump with the drain plug to the right hand side of the tractor. On all except a few of the early engines this will ensure that the cut-out in the flange will give access to the relief valve assembly. Replace the plug in the bottom of the balancing cylinder.

Barrels

Having removed the cylinder head, pistons and conn-rods, the barrels may be pulled out of the cylinder block with a straight upward pull. Remove the aluminium seals.

Replacement—It is essential to ensure that the tops of the two barrels are as near as possible in line with one another. Fit new aluminium seals under the barrels and tighten them down on to these using two nuts and distance pieces for each barrel. Place a straight edge across the top faces (not the top of the head spigot) and if there is a step of more than .001 in. (.025 mm.) adjust by peeling off one or two laminations of the bottom sealing washers as necessary. The laminations are .002 in. (.05 mm.) thick.

Fuel Injection Pump

The fuel injection pump, being driven by the engine camshaft can be removed and replaced without disturbing the timing. If a new pump is being fitted each cylinder will require adjustment to the timing by means of the tappets under the pump. Access to these is through the removable cover on the side of the pump support.

To remove the pump, disconnect the pipes and control rod, undo the securing nuts and lift off. The pump support may then be removed and the tappets and rollers lifted-out complete. Note the position of each tappet for replacement in the same bore. Separate the guide pin, tappet roller and bush, clean thoroughly and inspect for wear. The guide sleeves are replaceable but will require the removal of the camshaft to tap them out from below.

Replacement—Press new sleeves into the block ensuring that they are in the correct relative position. Fit the small dowel between the two to prevent rotation.

Fit the pump support and the roller tappet assemblies in the original positions. Turn the engine until the tappets are both at the bottom of their stroke and fit the pump.



FIG. 21
SPILL PIPE
FOR TIMING
INJECTION
PUMP

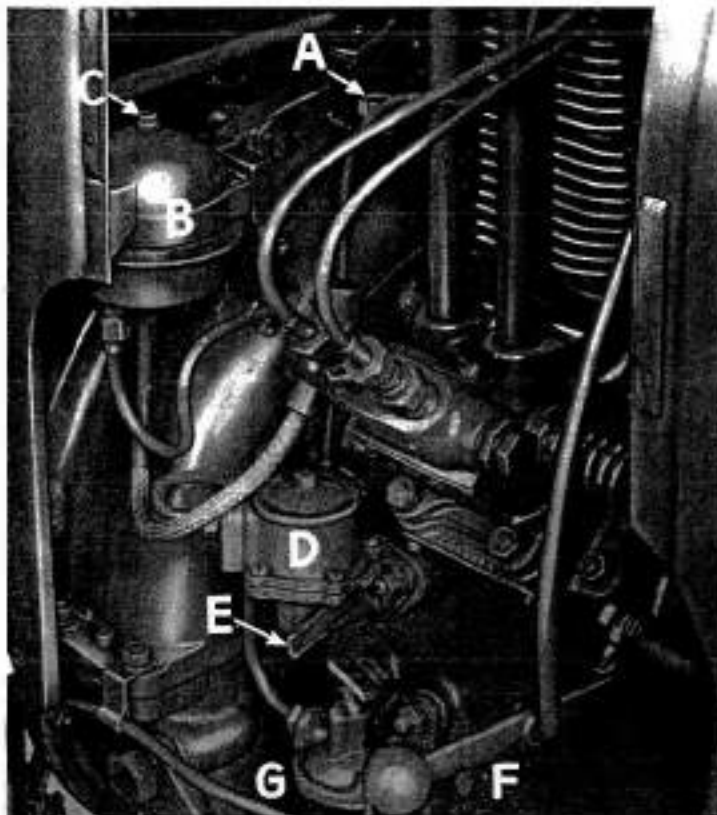


FIG. 22 FUEL SYSTEM

- | | |
|---------------------------|--------------------------------------|
| A. Timing inspection plug | E. Priming lever—fuel feed pump |
| B. Fuel filter unit | F. Decompressor lever |
| C. Fuel filter vent plug | G. Fuel tap and sediment bowl filter |
| D. Fuel feed pump | |

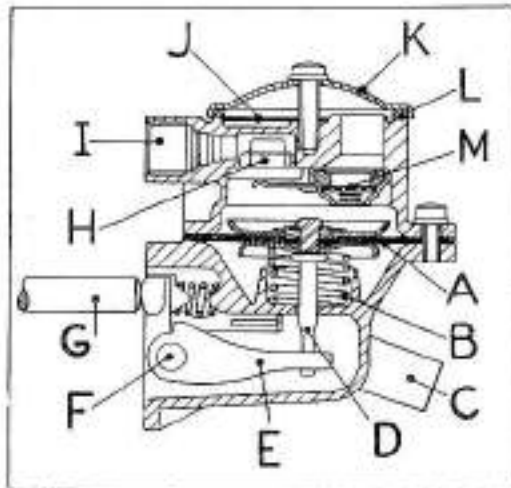
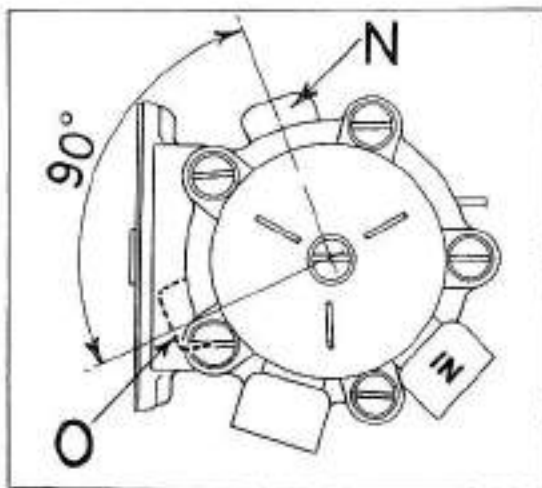


FIG. 23 A.C. FUEL LIFT PUMP

- | | |
|-----------------------|---|
| A. Diaphragm | I. Fuel outlet |
| B. Diaphragm spring | J. Filter screen |
| C. Priming lever | K. Filter cover |
| D. Diaphragm pull rod | L. Filter gasket |
| E. Link | M. Inlet valve |
| F. Rocker arm pivot | N. Position of tab when assembled |
| G. Push rod | O. Position of tab for inserting pull rod in link |
| H. Outlet valve | |

Timing the Injection Pump

Each element must be timed independently. Provided that the camshaft is correctly timed no difficulty should be experienced. If the original tappets and rollers have been fitted the timing should require very little alteration and should be checked as follows.

Remove the delivery valve and spring from the injection pump on No. 1 element and replace the outlet union. Attach a short length of injector pipe cut off at an angle and turned over in the form of a swan-neck as shown in fig. 21. If the engine is not in the tractor a small fuel tank made from a tin with a short length of pipe brazed in the bottom should be connected to the inlet of the fuel filter. Ensure that the rack is fully open. Bleed the system free of air. Turn the engine in the correct direction of rotation on the compression stroke of No. 1 cylinder (both inlet and exhaust valves closed). As the piston approaches the point of injection a free stream of fuel will run from the test pipe. Continue turning slowly until this slows up and finally cuts-off. Wipe the end of the pipe. The correct position of cut-off can be judged when the point is just reached at which a drop of fuel does not form within 6-7 seconds. When the spill cut-off is just reached check the timing mark on the flywheel. The line marked SP should line up with the pip on the outside of the plug on top of the flywheel housing. (See A fig. 22.) If the marks are not in line, adjustment must be made at the tappet and the timing checked again. Remove the side plate from the pump support and use two flat spanners. The lower nut is the locknut and the upper one adjusts the height of the tappet. Unscrew or move the spanner to the right to advance the timing and vice-versa.

Repeat the process for the other cylinder. Take care when checking to move the engine in its normal running direction to take up the backlash in the gears, and ensure that the engine is on the correct stroke.

If the tappets have been disturbed or new ones are being fitted make sure that the tappets are screwed fairly well down before assembly, otherwise the top of the pump plunger may contact the underside of the delivery valve seat while turning the engine and cause permanent damage. Set the flywheel on the SP mark and unscrew the tappet until the spill cuts off. Lock and recheck in the normal way.

Lift Pump

Remove the pipes, pump and push rod. Examine the push rod for wear. Remove the top cover and thoroughly clean out the sediment chamber and the gauze filter with petrol. Split the top and bottom halves if it is necessary to replace the diaphragm. Turn the diaphragm and pull rod through 90°. This will release the pull rod from the connecting link. Reverse the process when rebuilding. (See fig. 23.)

Timing Case Front

If the engine is out of the tractor remove the clutch and lay the engine on its flywheel on the bench for convenience.

Unfasten the rubber dust bellows on the injection pump and disconnect the push rod.

Using a box spanner remove the starter dog. Pull the fan pulley off the crankshaft on which it is located with a key.

Remove the eleven securing nuts and spring washers. Lift the timing case front off complete with the governor linkages.

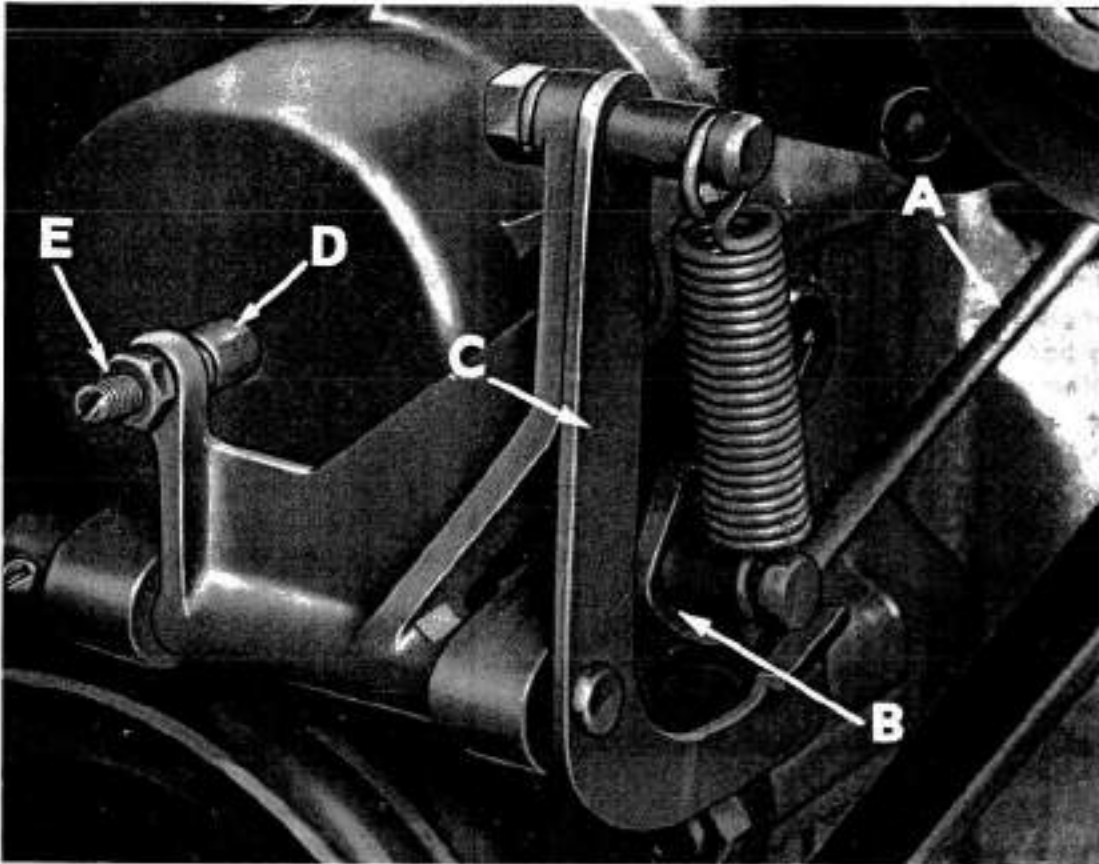


FIG. 24 GOVERNOR

- | | |
|------------------|-------------------------|
| A. Control rod | C. Lever (cam follower) |
| B. Cam | D. Push rod |
| E. Thrust button | |

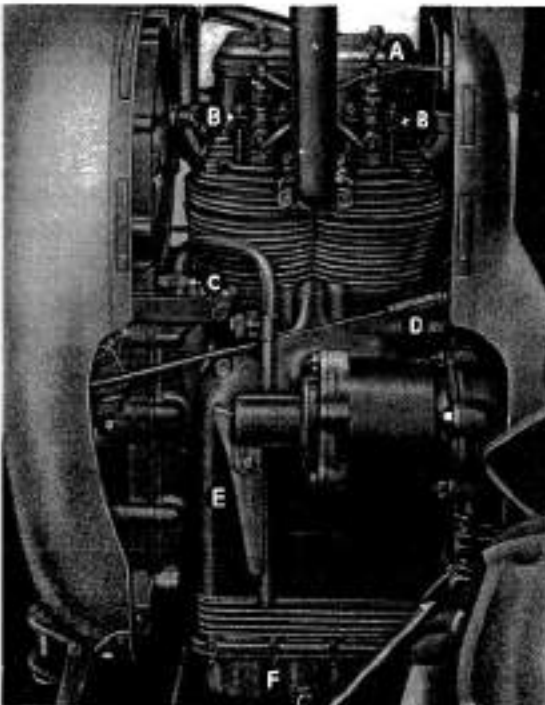


FIG. 25
ENGINE SIDE

- | |
|--|
| A. Excess fuel leak-off pipe |
| B. Injectors |
| C. Engine breather pipe |
| D. Control rod adjustment (max. speed) |
| E. Inertia starter engagement lever |
| F. Sump drain plug |

The governor thrust button and bearing will most likely remain between the bob weights and should be removed for safety.

Replacement—Firstly fit the key for the crankshaft pulley in the shaft and a new oil seal to the case. Fit a new paper gasket to the block, with a little grease to hold it if necessary, and ensure that the two dowels are in position.

When fitting the timing case with the governor housing in position, turn the engine so that the governor weights can be positioned apart. Fit the governor thrust button and ball race into the governor case and fit the timing case front to the engine.

Drive the fan pulley carefully into position with a suitable sleeve. Fit the original washers and starting dog. Tighten until the slot for the starting handle peg is at five minutes past seven o'clock with the engine on T.D.C. If this is not possible, remove the dog and fit shim washers as required.

Governor Adjustment

Where possible the adjustments to the governor should not be disturbed as the actual degree of governing can only be checked and measured on a dynamometer. However, if new parts have to be fitted, the governor dismantled, or the behaviour is suspect, the following procedure should be carefully followed in sequence, referring to fig. 24.

Close the hand throttle control so that the cam B is in contact with lever C at the follower pad. Screw out the thrust button E until it is clear of the push rod D.

Turn the engine by hand until the governor weights are one above the other. The lower weight will fall and move the push rod outwards. Make sure the push rod is still in contact with the weight (i.e., has not come out as far as it can). Screw the thrust button in until it just touches the push rod; screw in another half turn and lock. Check that the cam and lever are still in contact while this adjustment is made.

Start the engine and run at approximately 1,500 r.p.m. Adjust the length of the pump control rod (A fig. 11) by means of the adjusting nuts at the lever end of the rod so that the cam follower is $\frac{1}{32}$ in. to $\frac{1}{16}$ in. (0.08 mm. to 0.16 mm.) clear of the cam. Take care to keep the sleeve free in the hole through the lever and nipped tight between the nuts at each end.

Check that the cross shaft turns freely and that the sleeve on the control rod passes freely through the hole in the lever at any position of the lever. Check that the pump control rack also moves freely.

If the engine hunts after carrying out the above adjustments this may be corrected by a slight alteration of the control rod from the above setting.

With the engine stopped and the hand throttle lever three-quarters open, check that the rack moves into the full open position when the excess fuel button is pressed.

The maximum speed of the engine is set to 1,950 r.p.m. light load by means of the turnbuckle (D fig. 25) with the hand lever full open, and then the slow running to 600 r.p.m. by means of the adjustable stop on the hand lever. If stalling occurs when shutting down from a fast speed this will be due to slackness or play in the rods and levers between the hand throttle lever and governor cam.

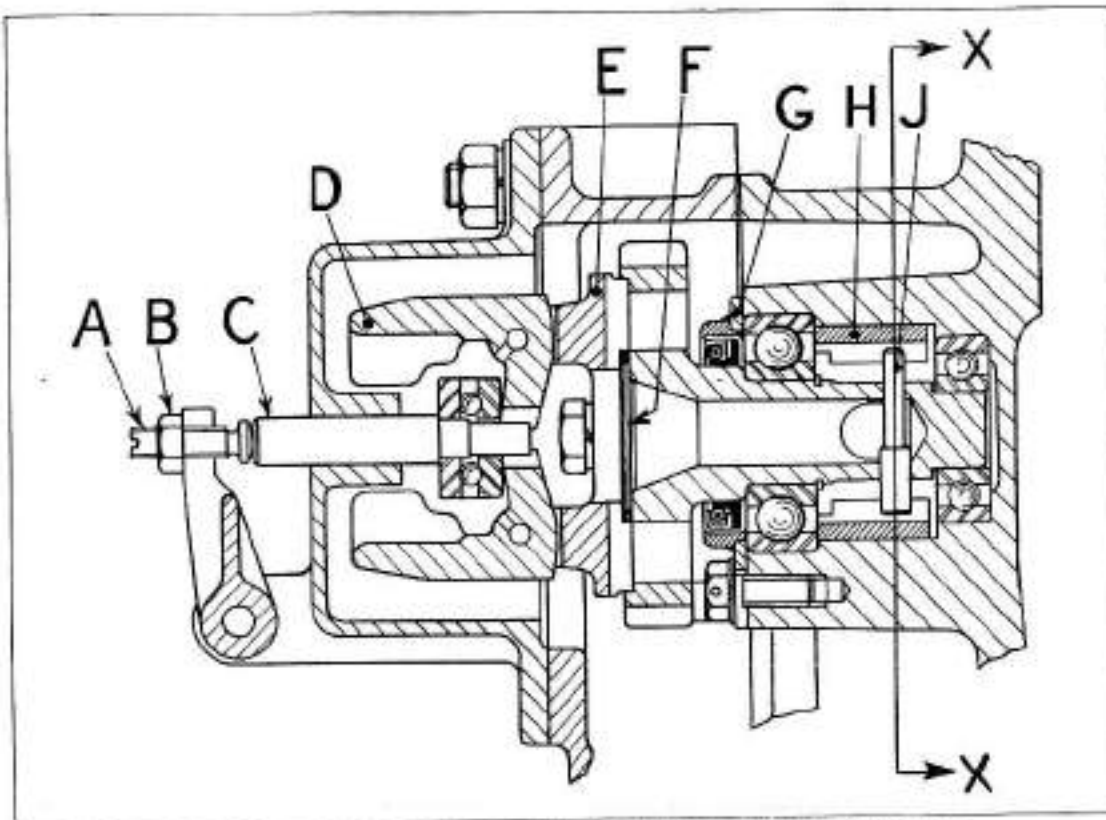
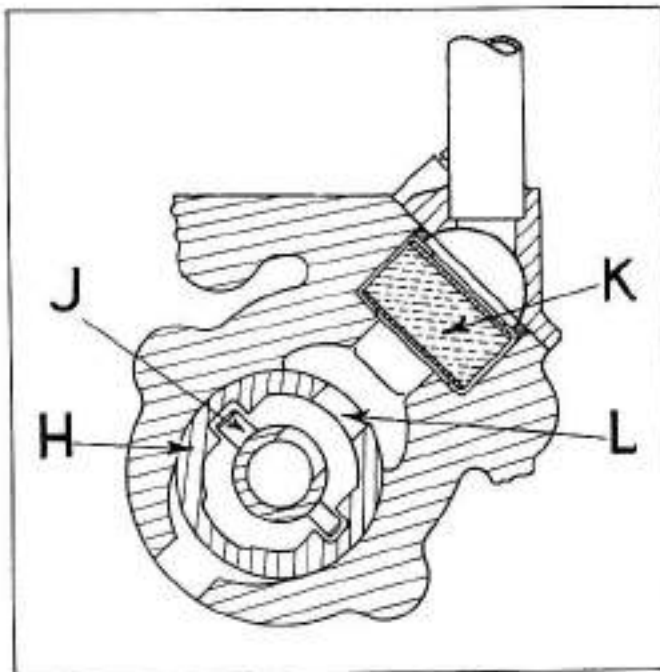


FIG. 26 SECTION OF ROTARY BREATHER AND GOVERNOR

- | | | |
|------------------|--------------------|------------------------|
| A. Thrust button | D. Governor weight | G. Oil seal |
| B. Locknut | E. Weight carrier | H. Rotary valve sleeve |
| C. Push rod | F. Gauze | J. Drive peg |
| K. Filter | L. Port | |



SECTION OF BREATHER AT X-X (See Fig. 26)

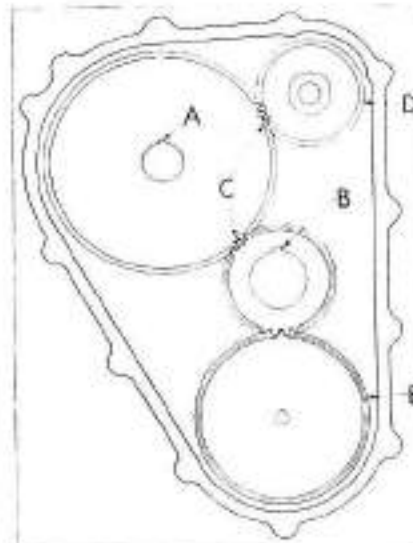


FIG. 27 TIMING OF THE GEARS

- | |
|---|
| A. Camshaft keyway |
| B. Crankshaft keyway |
| C. Position of centre punch marks at T.D.C. |
| D. Governor and breather gear |
| E. Oil pump gear |

Governor and Rotary Crankcase Breather

Firstly remove the timing case front. Unfasten the lock wire from the two bolts holding the bearing sleeve to the block just behind the governor gear. Slacken the two bolts and turn the sleeve clockwise to clear the bolts and pull the assembly out of the block. If the sleeve is tight and a slide hammer is not available it is permissible to unscrew the retaining bolts against the back of the gear and jack the assembly out. This must, however, only be done to start it moving because there is danger of spoiling the threads in the block when the bolts are nearly out.

Support the assembly in the vice by the bob weight carrier. Lever the inner ball race off with two screwdrivers. Lift off the breather rotor and knock out the driving pin. Remove the circlip and lever the outer ball race off the oil seal housing. Tap the oil seal out of the housing.

Replacement—Fit a new oil seal in the housing, taking care not to damage the seal. A guide sleeve with tapered end is a useful tool to enable the seal to be slid on to the sealing diameter. Press the outer ball race on to the gear shaft using a short tube and fit the circlip. Fit the drive pin with equal protrusion each side of the shaft. Fit the rotor with its hole in line with the hole in the shaft. Note that the driving pin has a large and small end and the slots in the rotor are wide and narrow to correspond. The lugs which form the slots are cut away at one end to clear the circlip and this end should be adjacent to the large ball race. Press on the small ball race.

Fit the assembly into the block with the crankshaft on T.D.C. and the timing centre punch marks in mesh. Remove the bob weight carrier to facilitate tapping into the block. Ensure that the retaining lugs on the sleeve are positioned so as to miss the retaining bolts. Turn the sleeve so that the lugs are under the bolts. Tighten and lock with wire. Replace the weight carrier with the gauze filter in place.

Timing Check—If it is desired for some reason to check the timing of the breather without removing the timing case front, it can be done by removing the breather outlet elbow. The breather is fully open at $13\frac{1}{2}^{\circ}$ before bottom centre of the crankshaft, therefore with the crankshaft on B.D.C., half the hole in the rotor will still be visible in the lower half of the breather outlet.

Camshaft and Tappets

Before the camshaft can be removed it will be necessary to remove the injection pump and tappet roller assemblies, and the lift pump and its push rod. The cylinder head and valve push rods will also have to be removed to allow the camshaft to be withdrawn.

Remove the timing case front as described previously. Check the end float and backlash. Remove the three set screws securing the plate behind the camshaft gear. Lift all the tappets out of the way and withdraw the camshaft and gear. (Some assistance may be required to keep all the tappets clear.) The tappet block may then be removed.

The camshaft gear is keyed on to the camshaft and may be removed after undoing the set screw in the end of the shaft.

Replacement—Examine the thrust washer; gear and retaining plate for wear. If the end float is excessive replace the washer and or retaining plate. If the gear teeth are badly worn or the backlash is excessive fit a new gear. The camshaft gear should

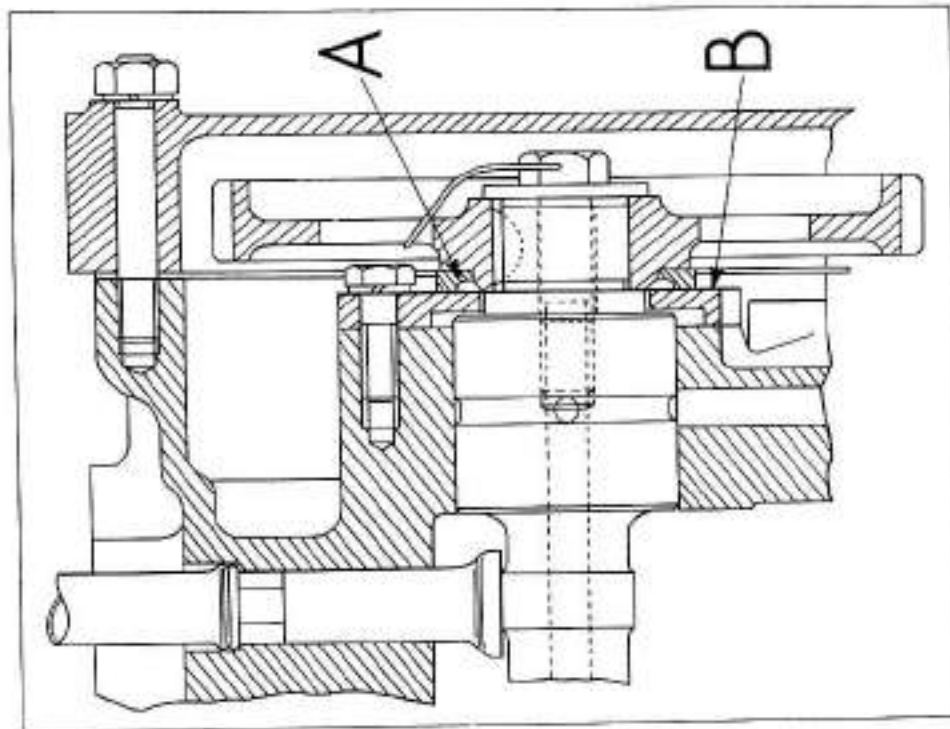


FIG. 28
SECTION OF CAMSHAFT AND TAPPET
 A. Thrust washer B. Retaining plate

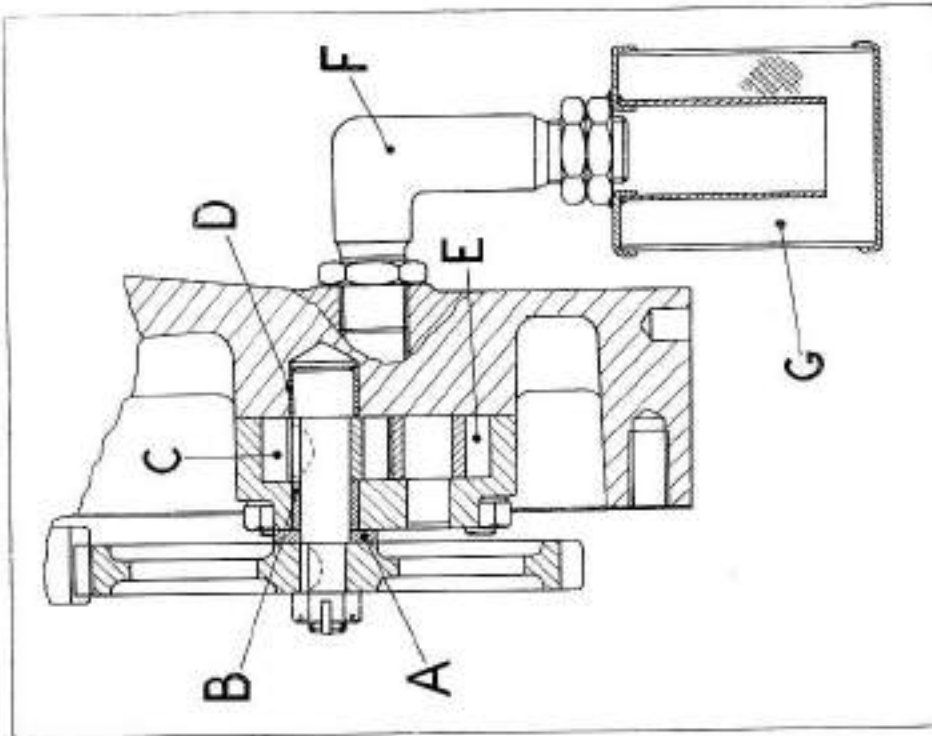


FIG. 29 SECTION OF OIL PUMP
 D. Inner bush
 E. Driven gear
 F. Pick-up elbow
 G. Pick-up strainer
 A. Thrust washer
 B. Outer bush
 C. Driving gear

also be replaced if worn. Examine the camshaft for wear, especially on the nose of the cams. Replace if excessively worn. Check the tappets for wear on the thrust face and also inside at the push rod ball end bearing.

Thoroughly lubricate and fit the tappet assembly with the step in the thrust washer towards the retaining plate, see fig. 28. Lock the gear retaining set screw with wire taking care that it will not foul the nuts of the retaining plate when revolving. The camshaft is timed by lining the centre punch marks on the gear teeth on either side of the corresponding tooth on the crankshaft gear. (See fig. 27.)

Oil Pump

It is preferable to remove the crankshaft gear first and check the pump gear for true running by spinning it. Any tightness in the oil pump may then be felt at the same time. Remove the gear and pull the front casing of the oil pump off the studs after removing the four nuts.

Replacement—Thoroughly clean and inspect the teeth and bearings for wear. The gears should be renewed as a pair. New bushes for the pump shaft are supplied ready reamed to size and only require pressing into place. The bush in the block may be difficult to remove because of lack of access to the rear. A useful method is to cut off a short length of hacksaw blade and grind the width down until it can be used to saw a slot in the bush. Take great care not to damage the housing as this is part of the block. When the bush is just sawn through, bend a corner of the bush near the cut inwards with a screwdriver and mallet. Collapse the bush inwards and withdraw with a pair of small pliers.

Assemble the pump, fit to the crankcase and fit the gear. Turn the gear and check for tight spots. If some tightness is found this can often be cured by slackening the pump housing and tapping the body one way or the other until a position of free running is found. Tighten and check again. Note that there is no gasket between the pump body and the cylinder block. The end clearance of the pump gears should be .001 in./ .004 in. (.025/.10 mm.). Check for running true and refit the crankshaft gear.

Oil Pump Gauze Filter and Elbow

Slacken the nut securing the oil pump gauze elbow to the crankcase. Turn the assembly so that a spanner can be used to slacken the gauze locknut. Remove the gauze. Turn the crankshaft to quarter of a turn from T.D.C. and unscrew the elbow out of the block.

Clutch

Remove the clutch assembly from the flywheel by releasing the bolts diagonally in stages.

Examine the clutch facings, the driving plate, and flywheel face for excessive wear or damage. The driven plate should be examined for uneven or worn splines, cracked segments, or damage at the junction of the disc and hub.

New clutch facings should be fitted if the old ones are badly worn or contaminated with oil and the centre plate is in good condition. Should the centre plate be damaged a complete new clutch disc should be fitted and the cause of damage investigated. This will most likely be due to misalignment. The face of the flywheel

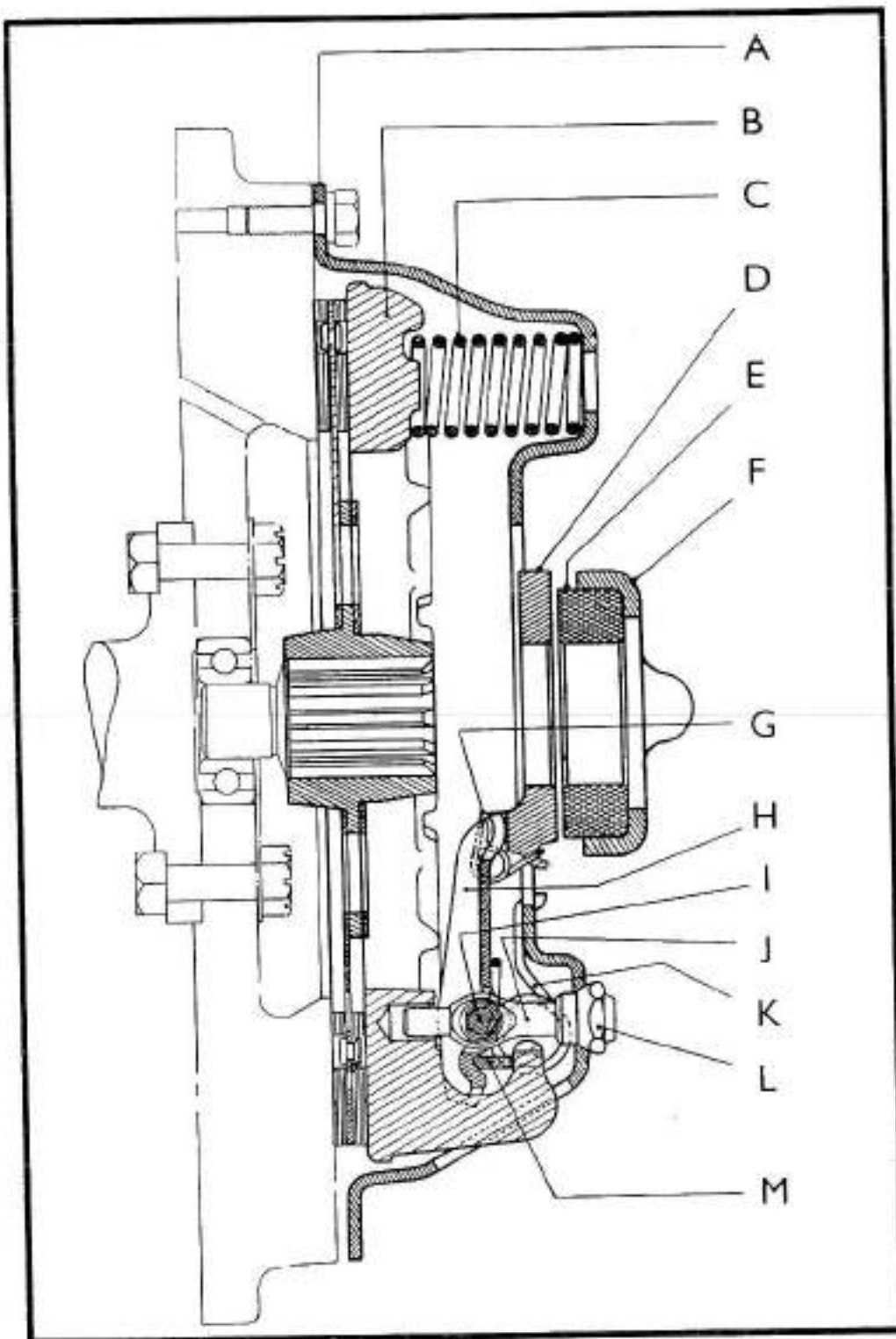


FIG. 30 SECTION OF CLUTCH

- | | |
|-----------------------------|------------------------|
| A. Cover | H. Release levers |
| B. Pressure plate | I. Floating pins |
| C. Thrust springs | J. Eyebolts |
| D. Release lever plate | K. Anti-rattle springs |
| E. Graphite release bearing | L. Adjustment nuts |
| F. Bearing cup | M. Strut |
| G. Retainer springs | |

should be tested with a dial gauge while the engine is slowly turned by hand. Run out should not exceed 0.003 in. (0.08 mm.). If greater, check the flywheel bolts for tightness and the fit of the flywheel on the crankshaft flange.

The clutch facings will attain a high polish after long service but this is of no detriment to the frictional properties of the clutch. If a small quantity of oil is allowed to come into contact with the clutch face it will burn off. The burning off of this small amount of oil has the effect of darkening the facings, provided that the polish on the facings remains such that the grain of the material can be clearly distinguished, it has little effect on clutch performance.

Should larger quantities of oil or grease gain access to the facings one of two conditions, or a combination of the two may arise.

(a) The oil may burn off and leave a carbon deposit which assumes a high glaze and causes slip. This is a very definite, though thin, deposit and in general hides the grain of the material.

(b) The oil may partially burn and leave a resinous deposit on the facings, which frequently produce a fierce clutch, and may also cause a "spinning" clutch due to a tendency of the facings to adhere to the flywheel or pressure plate face.

(c) There may be a combination of (a) and (b) which is likely to produce a judder during clutch engagement.

Still greater quantities of oil produce a black soaked appearance and the effect may be slip, or judder in engagement.

After fitting new clutch facings where oil has caused damage, the cause of the presence of oil should be removed and the flywheel face thoroughly cleaned.

Refacing Clutch Plates

Remove one of the original linings by drilling out the rivets, not by punching as this is liable to damage the tongues of the steel plate. Place the new facing on the plate with the countersunk holes resting on the convex segments. Insert the rivets with the heads on the plate side, and rivet the riveting end in the facing hole.

Remove and renew the second lining in similar manner.

NOTE.—If tools are available for rolling rivets instead of splitting them, the rivets should be inserted with the heads on the facing side and riveted against the steel plate.

After refacing, mount the driven plate on a mandrel between centres and check for "run-out" by means of a clock indicator set as near the edge as possible. Where "run-out" exceeds 0.015 in. (0.39 mm.) true the plate by prizing in the requisite direction after finding the high spots.

When assembling the driven plate in the flywheel, ensure that the larger chamfered spline end of the hub is towards the gearbox.

Line up the spigot bearing and the driven plate by means of the clutch shaft which has been removed from the gearbox or by a dummy shaft, before tightening the clutch cover securing screws. Do not remove the shaft until the screws are fully tightened.

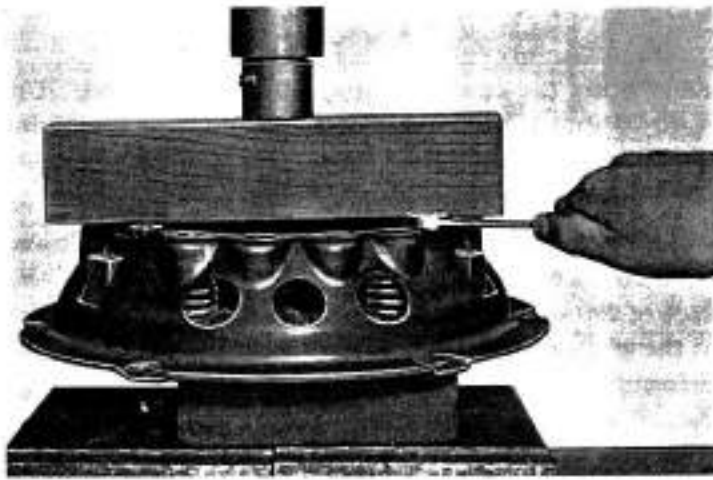


FIG. 31
CLUTCH ASSEMBLY
ON PRESS

FIG. 32
REMOVING THE
RELEASE LEVERS



FIG. 33
REPLACING THE STRUT
AND RELEASE LEVER

Dismantling the Cover Assembly—If it is found necessary to renew parts of the cover assembly this can be dismantled, re-assembled and adjusted with the aid of a press as follows:—

Mark the end of the eyebolts, adjusting nuts, cover and lugs of the pressure plate in some way so that they may be re-assembled in the same relative positions should new parts be unnecessary.

Place the assembly in an arbor press, or on the bed of a vertical drill as shown in fig. 31, with a block under the pressure plate arranged so that the cover is left free to move down. Place a block or bar, resting on the spring bosses, across the top of the cover. Compress the cover against the pressure plate and shear away the peening on the adjustment nuts by exerting sufficient turning pressure to the nuts. Remove the nuts from the eyebolts. Slowly release the pressure to prevent the springs from flying out, after which the cover can be lifted, disclosing all the internal parts.

To remove the release levers, grasp the lever and eyebolt between thumb and fingers as shown in fig. 32, so that the inner end of the lever and threaded end of the eyebolt are as near together as possible, keeping the eyebolt pin seated in its socket in the lever. The strut can then be lifted over the ridge on the end of the lever as shown, making it possible to lift the eyebolt off the pressure plate. Renew any parts showing wear.

Re-assembly—Note the positions of the marked components. Assemble the release lever, eyebolt and eyebolt pin, holding the threaded end of the eyebolt and inner end of the lever as close together as possible as shown in fig. 33. With the other hand insert the strut in the slots of the pressure plate lug sufficiently to allow the plain end of the eyebolt to be inserted in the hole provided in the pressure plate. The short end of the release lever will then be under the hook of the pressure plate. This will enable the strut to move upwards in the slots in the pressure plate lug, over the ridge on the short end of the lever, and to drop into the groove in the lever. Fit the remaining release levers in a similar manner.

Place the pressure plate on blocks of wood on the bed of the press and arrange the thrust springs in a vertical position on the plate, seating them in the bosses provided. Lay the cover over the assembled parts, ensuring that the anti-rattle springs are in position, that the tops of the thrust springs are directly under the seats in the cover, and that the machined positions of the pressure plate lugs are under the slots through which they have to pass.

Place the block of wood across the cover resting on the spring bosses, and compress the cover by means of the ram, guiding the eyebolts and pressure plate lugs through their respective holes. Screw the adjusting nuts on to the eyebolts. Operate the clutch a few times, using the spindle of the press on the inner ends of the levers, to ensure that the parts have settled in their correct positions.

Using a clutch setting gauge, adjust the adjusting nuts so that the thrust face of the release levers is 0.812 in. (20.6 mm.) from the flywheel face. Care should be taken to see that they are all at an equal height. When the setting is correct secure the adjusting nuts by peening over some metal into the slot in the eyebolt using a blunt cold chisel and a hammer.

Connect the release bearing ring to its retainer springs fitting a new one if the old one is worn.

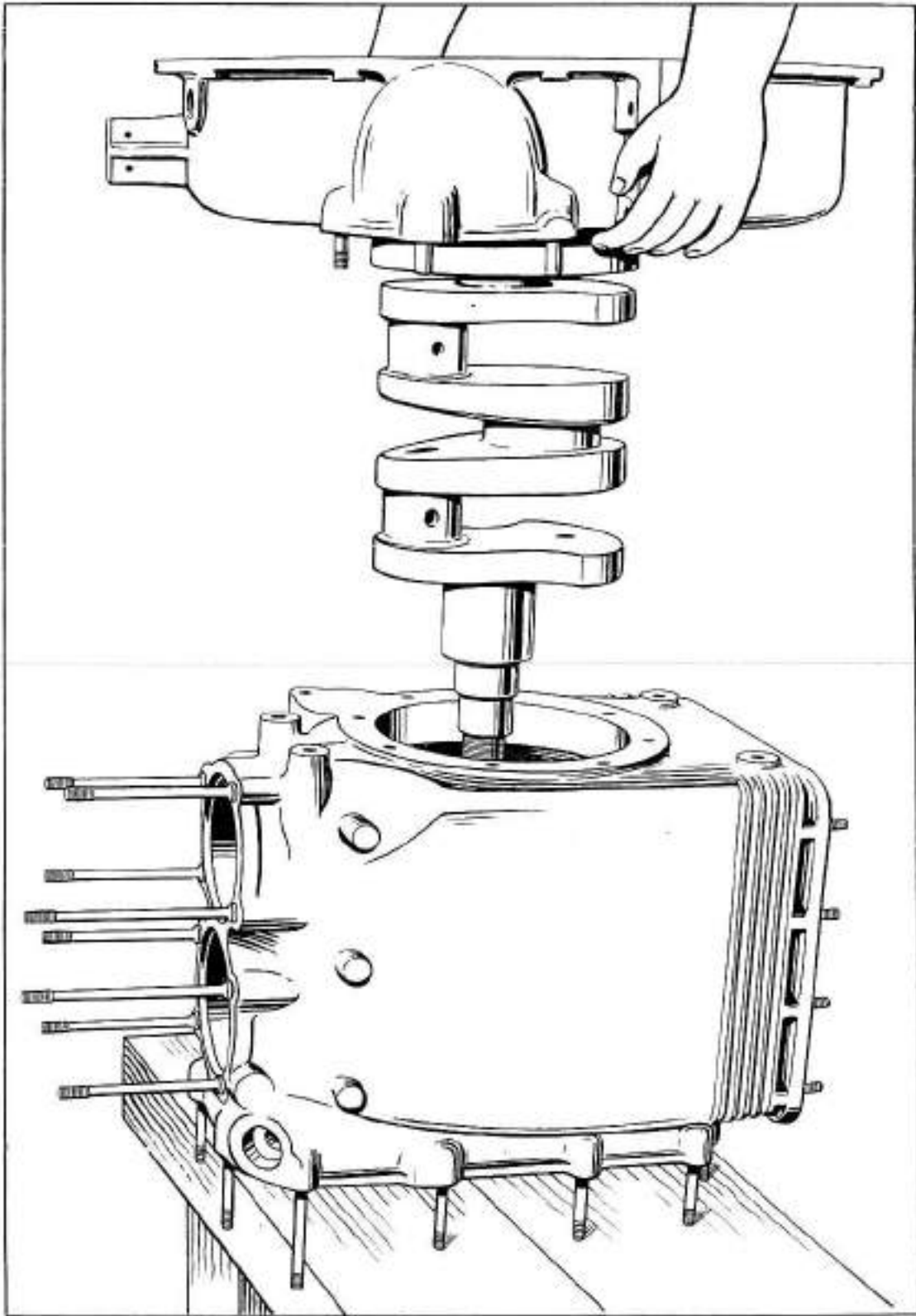


FIG. 34
REMOVING THE CRANKSHAFT

Flywheel

Untab the locking plate and remove the four nuts. Tap the flywheel with a soft mallet through the starter aperture, turn the flywheel a quarter of a turn and tap again. Repeat at quarter turns until free to lift off.

Crankshaft Gear and Crankshaft

Draw the crankshaft gear off the crankshaft taking care not to damage the corners of the teeth. Remove the key and take off the distance washers and white metal thrust washer.

The crankshaft cannot be removed without first removing the cylinder head, pistons and connecting rods, timing case and flywheel.

Remove the locking wire from the bolts securing the bell housing to the crankcase. Remove the 13 bolts. Stand the engine on the bell housing and lift the crankcase vertically off the bell housing and crankshaft. Remove the other thrust washer from the shaft. Split the bell housing and remove the crankshaft as follows:— Remove the nuts and bolts from the outside flange of the bell housing. Untab and remove the nuts and bolts passing through the bearing housing, two on the crankshaft side and two on the flywheel side. Remove the two short bolts in the joining flange on the flywheel side. Separate the two halves, taking care of the two dowels and bearing shells.

Replacement—Fit the bearing shells in the bell housing the white metal to the top half, the copper lead to the bottom. Ensure that the bearing housing and the backs of the shells are scrupulously clean. Apply a thin smear of oil to the backs of the shells. See that the tongues are correctly located. Apply a liberal coating of clean engine oil to the bearings and fit the two halves of the bell housing over the crankshaft. Fit the two dowels and the bolts with the heads uppermost. Fit new tab washers under the nuts.

NOTE.—The top and bottom halves of the bell housing are machined as a pair and should only be replaced as a unit. Identical identification numbers are stamped on the flanges of each half.

Fix a new paper gasket to the cylinder block with grease not forgetting the four paper discs for the bolt bosses. Ensure that the main bearing in the cylinder block is clean and lubricated with engine oil. Fit the inner thrust washer to the crankcase with grease, the white metal face towards the crankshaft. Check that the flywheel bolts are fitted in the crankshaft flange. Lower the crankcase on to the crankshaft and enter the first bolt by putting the hand through the starter opening. Turn the assembly on to the sump face allowing the flywheel housing to overhang the end of the bench. Fit the remaining bolts with plain washers under each taking care not to use those intended for the cylinder head which are thicker and slightly smaller on the outside diameter. Early engines were locked with wire but later ones use star lock washers.

Turn the block on to the bell housing with a block of wood under the flywheel flange to support the crankshaft. Fit the front washer and the distance washer on the front of the crankshaft. Fit the key and the crankshaft gear with the boss towards the crankcase. This should be a drive fit on the shaft. Fit the fan drive pulley and dog to hold the gear in place. Remove the block of wood and check the end float of the crankshaft. Remove the dog and fan pulley.

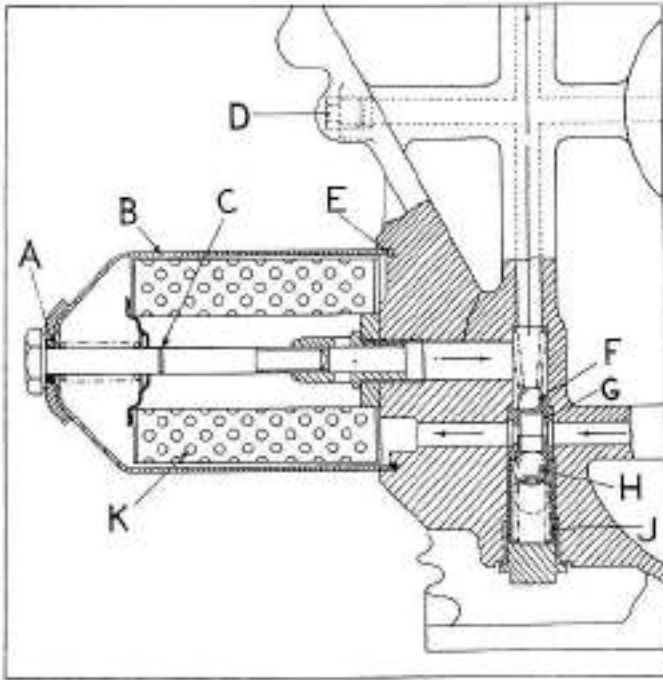


FIG. 35
SECTION OF OIL CLEANER
AND RELIEF VALVE

- A. Sealing ring
- B. Filter body
- C. Circlip
- D. Oil gauge connection
- E. Rubber seal ring
- F. By-pass relief valve
- G. Valve seat insert
- H. Main relief valve
- J. Retaining sleeve
- K. Filter element

FIG. 36
TOOL FOR MAIN BEARING

- A. 6 in. (152.5 mm.)
- B. 2½ in. (63.5 mm.)
- C. 2.645/2.643 in. (67.183/67.132 mm.) dia.
- D. 2.498/2.496 in. (63.449/63.398 mm.) dia.

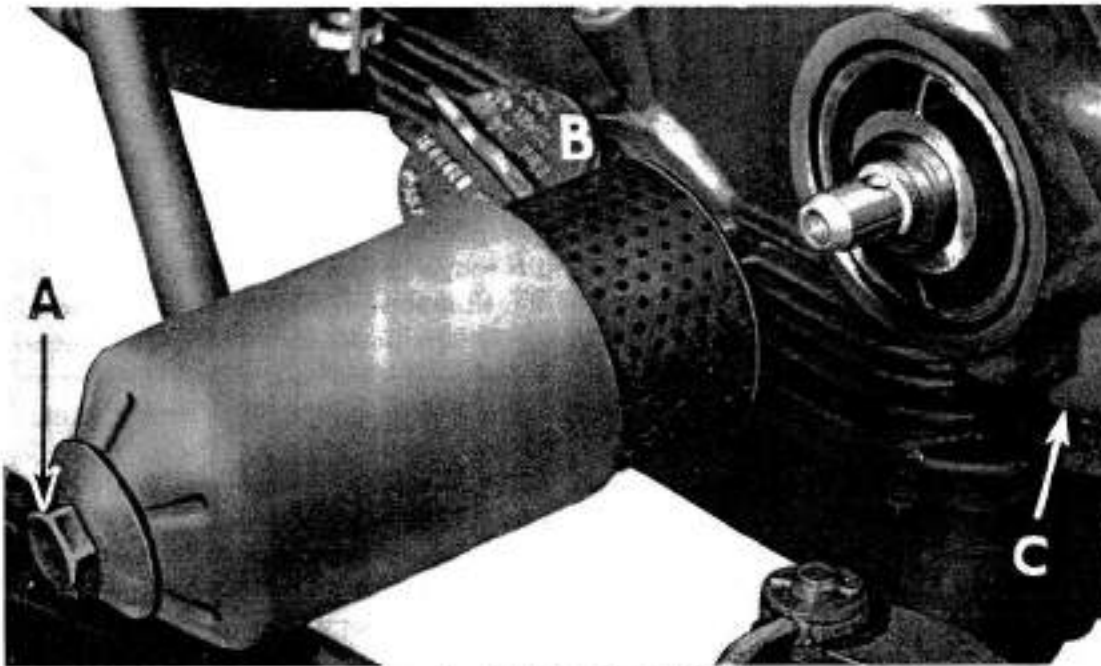
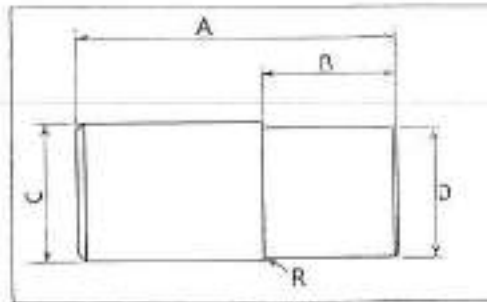


FIG. 37 ENGINE OIL FILTER
A. Cover bolt B. Element C. Relief valve location

Main Bearing (Timing Case End)

This bearing is a split steel backed lead bronze shell pressed into the block. If badly worn or scored press the shell out of the block and fit a new bearing. Make a press tool as shown in fig. 36. Accurate machining of this tool is necessary and a clean square shoulder should be cut. Support the crankcase firmly on the block to bell housing face and press the shell through into the block. If difficulty is experienced in starting the movement of the shell it is permissible to make a saw cut in the shell but great care should be taken not to damage the housing.

Replacement—Ensure that the housing and the back of the shell are clean, apply a thin film of oil and press into the housing using the same tool as before. The shell should be fitted centrally in the housing, i.e., about $\frac{1}{32}$ in. (.8 mm.) from each end and the join at one side or the other. If a suitable press is not available it is possible to hammer the bearing in or out using the same tool and a heavy mallet. Saw cutting is recommended before hammering the bearing out but a press should be used if available.

Oil Cleaner and Relief Valve Assembly

Figure 35 shows a section of the relevant parts. The seal A under the head of the filter retaining bolt may require replacement occasionally. After removal of the circlip C the bolt may be withdrawn. The seal E in the cylinder block should be renewed whenever there are signs of cutting, or oil leakage, and always at each overhaul.

The main relief valve commences to open at about 40 lb./sq. in. (2.8 kg./sq. cm.) and is controlled by the lower ball H. The upper ball F controls the by-pass round the oil filter. Should the resistance to flow through the filter exceed 15 lb./sq. in. (1.05 kg./sq. cm.) the valve will commence to open and allow oil direct to the crankshaft.

Should the valve seats be suspect the seat insert G is threaded and may be extracted with a $\frac{3}{8}$ in. B.S.F. bolt. Note that the upper spring is tapered and that the small end fits against the ball. If this spring is refitted the wrong way round the ball will slip inside the spring and the oil will permanently by-pass the filter with consequential heavy wear to the engine. The sleeve J is provided to retain the seat insert in the correct position in the event of it being a slack fit. No adjustment to opening pressure is provided. An oil pressure gauge or warning system may be connected at the plug D if required. This is tapped $\frac{3}{8}$ in. Whit.

STATIONARY ENGINE

The basic engine unit of the SD2 and MD2 engines is the same as that used in the tractor and servicing will be similar. However, the enveloping cooling cowl will have to be removed to gain access to the injectors, rockers, cylinder head and cylinder.

Fig. 38 shows a section through the output shaft bearings. If the housing is unbolted from the clutch housing the shaft and bearings will come away complete. Before withdrawing, ensure that the clutch is in engagement or the clutch plate will drop out of position and it will be impossible to replace the shaft.

The end cover may be removed for replacement of the outer oil seal. The shaft can then be pressed out and access gained to the inner oil seal and bearing.

End float of the shaft is governed by the shims under the end cover plate and should be adjusted to give 0.002/0.005 in. (0.05/0.13 mm). The shims are 0.005 in. (0.13 mm.) thick.

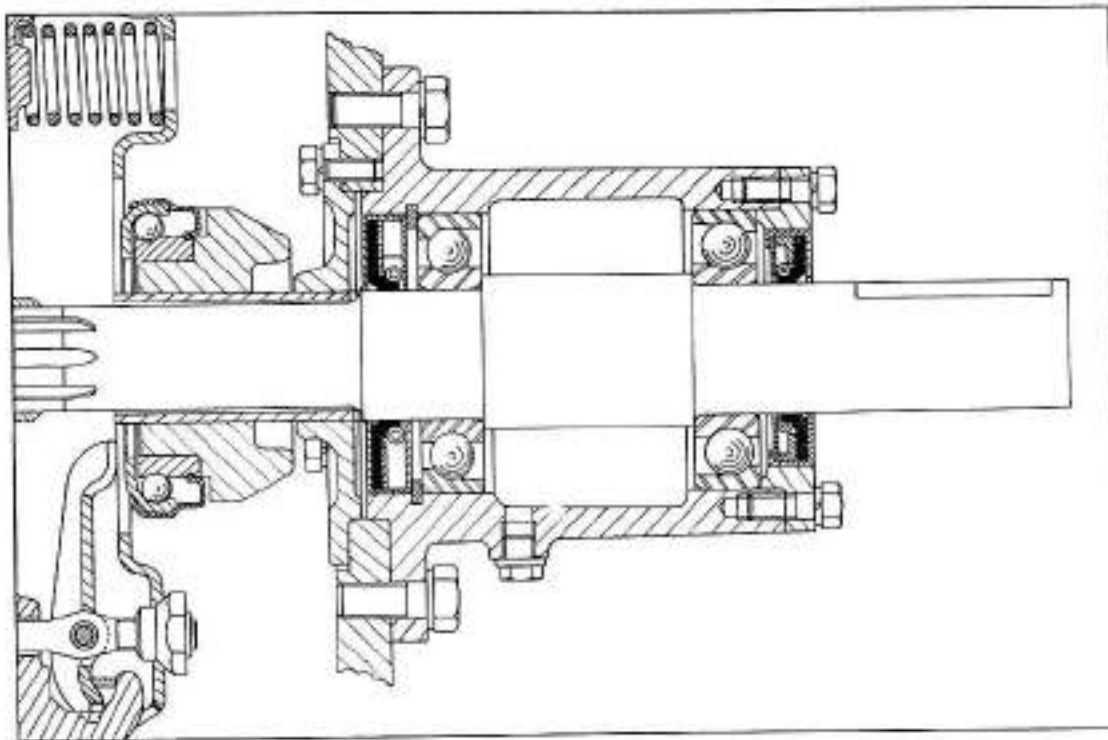


FIG. 38 SECTION OF SD2 12 OUTPUT BEARING

DIMENSIONAL DATA

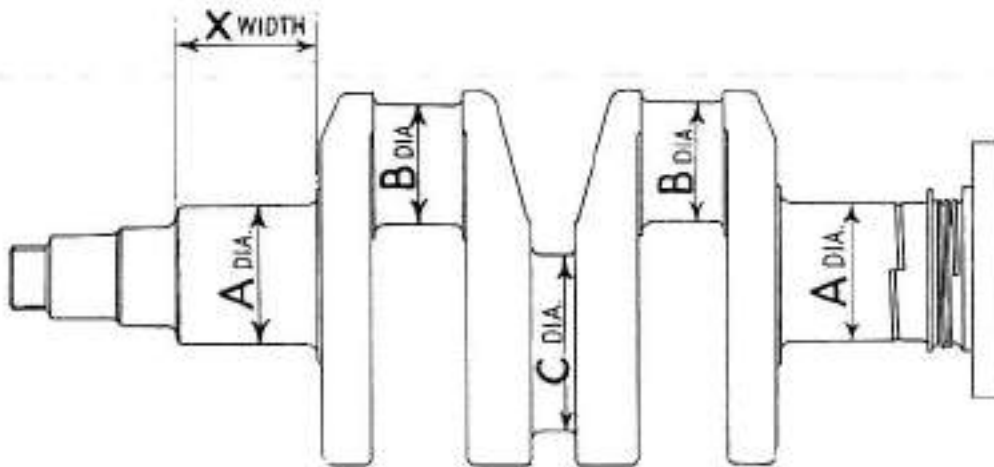


FIG. 39 CRANKSHAFT REGRIND DIAGRAM

Dimension		-0.010 in. -0.254 mm.	-0.020 in. -0.508 mm.	-0.030 in. -0.762 mm.
A	in.	2.4885/2.488	2.4785/2.478	2.4685/2.468
	mm.	63.208/63.195	62.954/62.941	62.700/62.687
B	in.	2.113/2.112	2.103/2.102	2.093/2.092
	mm.	53.670/53.645	53.416/53.391	53.162/53.137
C	in.	3.1077/3.1067	3.0977/3.0967	3.0877/3.0867
	mm.	78.936/78.910	78.682/78.656	78.428/78.402

		+0.010 in. +0.254 mm.	+0.020 in. +0.508 mm.
X	in.	2.512/2.510	2.522/2.520
	mm.	63.805/63.754	64.059/64.008

Description		Nominal Dimension	Remarks
Crankshaft (Std.)	..		See Fig. 39 for details of regrinding
Crankpin	.. ..	2.122 in. 53.90 mm.	
Crankpin—Balancing			
Cylinder	.. ..	3.117 in. 79.17 mm.	
Con-rod side clearance	.. ..	.008/.012 in. .20/.30 mm.	
Main Journals	.. ..	2.498 in. 63.45 mm.	
Main Bearings	.. ..	2.500 in. 63.50 mm.	
End Float of Crankshaft	.. ..	.002/.010 in. .05/.25 mm.	
Thrust Washer Thickness			
Std.	.. ..	.092 in. 2.34 mm.	
+ .005 in.	.. ..	.097 in. 2.46 mm.	For use with reground crankshafts
+ .010 in.	.. ..	.102 in. 2.59 in.	

Description	Nominal Dimension		Remarks
Pistons			
Ring Gaps010/.015 in. .25/.38 mm.	
Gudgeon pin diameter..	1.250 in.	31.75 mm.	Push fit in small end. Light drive fit in piston
Balancing Piston			
Clearance in bore002/.004 in. .05/.10 mm.	Engine cold
Gudgeon pin diameter..	.874 in.	22.20 mm.	Push fit in small end Light drive fit in piston
Connecting Rod Alignment			
Maximum permissible error in alignment between small end and big end bores, i.e., parallelism and twist measured per inch of mandrel length — 0.0005 in. (.013 mm.)			
Cylinder Bores			
Std.	3.500 in. 88.90 mm.	
+ .020 in.	3.520 in. 89.41 mm.	
+ .040 in.	3.540 in. 89.92 mm.	
Camshaft			
Journals	1.998 in. 50.75 mm.	
Bearing Bores	2.000 in. 50.80 mm.	
Oil Pump			
Side clearance of gears..	.001/.004 in.	.025/.10 mm.	
Inner Bush bore625 in. 15.87 mm.	Reamed in position
Inner Bearing624 in. 15.85 mm.	
Outer Bush bore500 in. 12.70 mm.	Reamed in position
Outer Bearing498 in. 12.65 mm.	
Thrust Washer Thickness	.125 in.	3.17 mm.	
Valves and Guides			
Guide bore344 in. 8.74 mm.	
Valve Stem—Exhaust338 in. 8.58 mm.	
—Inlet341 in. 8.66 mm.	
Rocker Bush741 in. 18.82 mm.	Broached in position
Rocker Shaft Dia.748 in. 19.00 mm.	

Description	Nominal Dimension
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Injection Pump Tappets

Tappet Body873 in.	22.17 mm.
Tappet Sleeve bore875 in.	22.22 mm.

End Floats

Crankshaft .. ..	.002/.010 in.	.05/.25 mm.
Camshaft .. ..	.012/.025 in.	.30/.63 mm.
Oil Pump .. ..	.004/.021 in.	.10/.53 mm.
Side clearance of oil pump gears001/.004 in.	.02/.10 mm.

Valve Clearance

Inlet and Exhaust004 in. SET COLD (.10 mm.)	
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Valve Timing

- Inlet opens 3° before top centre
- Inlet closes 38° after bottom centre
- Exhaust opens 36° before bottom centre
- Exhaust closes 10° after top centre

Spill Timing (Injection Pump)

Each cylinder set separately to 27° before top centre (SP. mark on flywheel).

Maximum Fuel Setting

Measured on Hartridge Test Machine using a dummy cam box 3.4-3.5 ccs. per element per 100 strokes at 600 r.p.m. pump speed.

Tightening Torque Figures

Cylinder Head nuts ..	44 lb./ft.	6.07 Kg.M.
Balancing Piston big end studs	17 lb./ft.	2.35 Kg.M.
Balancing Piston big end nuts	34 lb./ft.	4.69 Kg.M.
Connecting Rod big end nuts	40 lb./ft.	5.52 Kg.M.

	Studs in Aluminium		Nuts on Studs	
$\frac{1}{8}$ in.	3 lb./ft.	.41 Kg.M.	8 lb./ft.	1.10 Kg.M.
$\frac{5}{16}$ in.	5 lb./ft.	.69 Kg.M.	15 lb./ft.	2.07 Kg.M.
$\frac{3}{8}$ in.	8 lb./ft.	1.10 Kg.M.	26 lb./ft.	3.59 Kg.M.
$\frac{7}{16}$ in.	12 lb./ft.	1.66 Kg.M.	40 lb./ft.	5.52 Kg.M.

